Screening Analysis for EPACT-Covered Commercial HVAC and Water-Heating Equipment

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A.1 Introduction

Modeling the commercial buildings and equipment using the Building Loads and Systems Thermodynamics (BLAST) simulation tool (BLAST 1991) required assumptions about the buildings' internal loads; key envelope characteristics; occupancy characteristics; ventilation rates; and heating, ventilating, and air-conditioning (HVAC) and service water-heating (SWH) equipment operation schedules. This appendix describes the building characteristics that were used in estimating the loads for the representative building types selected for the screening analysis.

For heating and cooling equipment, the annual energy use is a function of, among other things, the heating or cooling loads the equipment must meet. These loads can vary by hour of the day, day of the week, and time of the year. The variations are driven by factors such as the type of building in which the equipment is installed; the activities and internal loads (lighting, occupant, and receptacle loads) in the building; and the buildings' internal and external environmental conditions, ventilation rates, and HVAC control strategy. Consequently, building type is a convenient descriptor for categorizing the nature of loads the HVAC equipment must meet. For SWH equipment, annual energy consumption depends on the demand for hot water. This demand can be also be linked to building type by the activities that create the demand.

A.2 Lighting and Plug Load Assumptions

Lighting and plug loads represent a significant fraction of building internal loads for many representative building types. Typically, these loads are represented by a peak power density (in watts per square foot) and a profile that describes the hourly magnitude with respect to the peak. These profiles are typically "hat-shaped" with a "crown" representing the peak period and a "brim" representing the off-hours (base-load). In between the "crown" and "brim" is a transition period representing the period between when the light and plug loads first start to increase and when these loads are fully "on" during the "crown" period. The significant characteristics of the profile are the duration of the "crown," the duration of the transition period, and the relative magnitude of the off-hour "brim" with regard to the peak.

The peak load and profile are unique for each building, but much similarity exists for buildings of the same type and occupancy. While each building is unique, building performance researchers often choose a representative description of the lighting and plug loads for simulation purposes. In the energy efficiency standards arena, the American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc. (ASHRAE) Standing Standards Project Committee (SSPC) 90.1 has developed several typical profiles for use in their energy cost budget (ECB) compliance method, which estimates the annual energy consumption of a design building. These profiles, while not representative of any particular building, reflect the professional judgment of the members of the committee about the appearance of plug and light profiles for various building types. This judgment is influenced by another major source of information–metered data from individual buildings. These data are available from several sources and are usually collected by utilities or government agencies for use in energy conservation and demand-side management programs.

For the screening analysis, lighting and equipment load profiles were developed from the profiles recommended by ASHRAE for each of the building types considered. Where metered data were available, observed peak and base loads were used to scale the profiles to reflect loads observed in "real" buildings. In addition, adjustments were made as necessary to the duration of "on" periods to reflect typical occupancy patterns observed in the Commercial Building Energy Consumption Survey (CBECS) data (EIA 1992, 1995).

The lighting and plug load profiles in Standard 90.1-1989 (ASHRAE 1989a) were modified through ASHRAE's addenda process. ASHRAE's proposed Addendum 90.lj to Standard 90.1-1989 (referred to as "Addendum 90.1j" in this appendix) revises several simulation profiles by increasing the magnitude of off-hour loads. These load shapes were selected as the basis for the Phase-I analysis (Barwig et al. 1996), and therefore were selected for the screening analysis, as well for the seven representative building types.

ELCAP developed profiles for several commercial building types (Taylor and Pratt 1989; Taylor and Pratt 1990; Taylor 1992). Taylor and Pratt (1989) provide average profiles for several building types, Taylor (1992) provides more detailed average information for five building types, and Taylor and Pratt (1990) provide similar information for individual retail and office buildings. Kasmar (1992) provides useful profile information for several building types. Metering the DOE Headquarters Building by the Federal Energy Management Program (FEMP) provided plug and light profiles for this building as documented in Halverson et al. (1994).

A.2.1 Lighting and Plug Load Schedules and Peak Intensities

The ASHRAE profiles were modified for use in the screening analysis by scaling their base-to-peak load ratios to match observations in metered data available for many of the building types. Profiles used for buildings without sufficient available metered data were unmodified in terms of base and peak loads. Tables A.1 and A.2 show the peak- and base-load intensities used to normalize the ASHRAE profiles. Table A.3 shows the hourly lighting and plug load fractions for the commercial building types for weekdays, Saturdays, and Sundays/holidays. These fractions multiplied by the peak-load intensity give the actual load intensity for each hour.

A.2.2 Lighting Densities

The lighting peak power density for each representative building was estimated at the level the buildings would use in 2015. Base-load values for light and plug loads and peak-load values for plug loads were drawn from the metered data sources to refine values supplied by ASHRAE for use with their

Table A.1. Lighting Load Intensities Used to Normalize the ASHRAE Hourly Profiles for the Screening Analysis

	Lighting (W/ft^2)					
	Weekday		Saturday		Sunday/Holiday	
Building Type	**Peak**[(a)]	**Base**	**Peak**[(a)]	**Base**	**Peak**[(a)]	**Base**
Assembly	2.25	0.45	2.25	0.13	2.25	0.13
Education	0.90	0.10	0.10	0.10	0.10	0.10
Food Service	1.60	0.30	1.60	0.30	1.60	0.30
Lodging	1.26	0.14	1.26	0.14	0.98	0.14
Office	1.47	0.26	0.68	0.26	0.26	0.26
Retail	1.50	0.27	1.35	0.27	0.90	0.27
Warehouse	0.60	0.10	0.10	0.10	0.10	0.10

(a) The peak lighting loads used for the actual simulation were based on estimated peak design lighting intensity levels that would be expected for 2015.

Table A.2. Plug Load Intensities Used to Normalize the ASHRAE Hourly Profiles and BLAST Simulations for the Screening Analysis

	Plug Loads (W/ft^2)					
	Weekday		Saturday		Sunday/Holiday	
Building Type	**Peak**	**Base**	**Peak**	**Base**	**Peak**	**Base**
Assembly	0.19	0.10	0.13	0.10	0.16	0.10
Education	0.48	0.01	0.01	0.01	0.01	0.01
Food Service	1.20	0.50	1.20	0.50	1.20	0.50
Lodging	0.23	0.10	0.18	0.10	0.20	0.11
Office	0.64	0.30	0.45	0.30	0.30	0.30
Retail	0.40	0.10	0.36	0.10	0.24	0.10
Warehouse	0.15	0.10	0.10	0.10	0.10	0.10

profiles. Metered data were available for five of the DOE commercial building types (education, food service, office, retail, and warehouse). For assembly and lodging building types, the peak and base loads for plugs, and base load for lights were the values provided by ASHRAE.

The year 2015 lighting power density estimates were derived using a combination of interior space type lighting models and estimated future lighting technology and application trends. This combination allows the estimates to be based on individual components of a lighting power density (design elements, technologies, application where known) rather than an escalation of any existing power density values.

Table A.3. Lighting and Plug Load Schedules for BLAST Runs (fraction of weekday peak loads)

Building Type	Peak Densities	Day of Week	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Assembly	Lighting 1.59 W/ft^2	Weekday	0.20	0.20	0.20	0.20	0.20	0.20	0.63	0.63	0.63	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.47	0.20
		Sat.	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.62	0.62	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.62	0.06
		Sun.	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.49	0.49	0.49	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.49	0.06
	Plugs 0.19 W/ft^2	Weekday	0.53	0.53	0.53	0.53	0.53	0.53	0.78	0.78	0.78	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.69	0.53
		Sat.	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.61	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.53	0.53
		Sun.	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.69	0.69	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.53	0.53
Education	Lighting 1.45 W/ft^2	Weekday	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.38	0.90	1.00	1.00	1.00	0.86	0.86	0.86	0.76	0.57	0.57	0.43	0.43	0.43	0.38	0.11	0.11
		Sat.	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
		Sun.	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
	Plugs 0.48 W/ft^2	Weekday	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.32	0.32	0.32	1.00	1.00	0.84	0.84	0.84	0.74	0.53	0.53	0.37	0.37	0.37	0.32	0.02	0.02
		Sat.	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
		Sun.	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Food Service	Lighting 1.75 W/ft^2	Weekday	0.43	0.28	0.19	0.19	0.19	0.33	0.52	0.52	0.71	0.71	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.90	0.90	0.71	0.62
		Sat.	0.43	0.28	0.19	0.19	0.19	0.19	0.33	0.43	0.71	0.71	0.90	0.90	0.90	0.90	0.90	0.90	0.90	1.00	1.00	1.00	1.00	0.81	0.71	0.62
		Sun.	0.43	0.28	0.19	0.19	0.19	0.19	0.33	0.43	0.71	0.71	0.90	0.90	0.90	0.90	0.90	0.90	0.90	1.00	1.00	1.00	1.00	0.81	0.71	0.62
	Plugs 1.2 W/ft^2	Weekday	0.59	0.49	0.42	0.42	0.42	0.52	0.66	0.66	0.79	0.79	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.93	0.93	0.79	0.73
		Sat.	0.59	0.49	0.42	0.42	0.42	0.42	0.52	0.59	0.79	0.79	0.93	0.93	0.93	0.93	0.93	0.93	0.93	1.00	1.00	1.00	1.00	0.86	0.79	0.73
		Sun.	0.59	0.49	0.42	0.42	0.42	0.42	0.52	0.59	0.79	0.79	0.93	0.93	0.93	0.93	0.93	0.93	0.93	1.00	1.00	1.00	1.00	0.86	0.79	0.73
Lodging	Lighting 1.54 W/ft^2	Weekday	0.22	0.17	0.11	0.11	0.11	0.22	0.44	0.56	0.44	0.44	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.67	0.89	1.00	0.89	0.67	0.33
		Sat.	0.26	0.26	0.11	0.11	0.11	0.11	0.41	0.41	0.56	0.56	0.41	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.85	1.00	1.00	1.00	0.85	0.41
		Sun.	0.22	0.22	0.11	0.11	0.11	0.11	0.22	0.33	0.33	0.22	0.22	0.22	0.22	0.11	0.11	0.11	0.11	0.11	0.44	0.67	0.78	0.56	0.44	0.22
	Plugs 0.23 W/ft^2	Weekday	0.51	0.48	0.44	0.44	0.44	0.51	0.65	0.72	0.65	0.65	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.79	0.93	1.00	0.93	0.79	0.58
		Sat.	0.50	0.50	0.44	0.44	0.44	0.44	0.56	0.56	0.61	0.61	0.56	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.72	0.78	0.78	0.78	0.72	0.56
		Sun.	0.56	0.56	0.49	0.49	0.49	0.49	0.56	0.62	0.62	0.56	0.56	0.56	0.56	0.49	0.49	0.49	0.49	0.49	0.69	0.82	0.89	0.76	0.69	0.56
Office	Lighting 1.32 W/ft^2	Weekday	0.18	0.18	0.18	0.18	0.18	0.23	0.23	0.42	1.00	1.00	1.00	1.00	0.90	1.00	1.00	1.00	1.00	0.61	0.42	0.42	0.32	0.32	0.23	0.18
		Sat.	0.18	0.18	0.18	0.18	0.18	0.18	0.23	0.23	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.18	0.18	0.18	0.18	0.18	0.18	0.18
		Sun.	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
	Plugs 0.64 W/ft^2	Weekday	0.47	0.47	0.47	0.47	0.47	0.50	0.50	0.63	1.00	1.00	1.00	1.00	0.94	1.00	1.00	1.00	1.00	0.75	0.63	0.63	0.56	0.56	0.50	0.47
		Sat.	0.47	0.47	0.47	0.47	0.47	0.47	0.52	0.52	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.47	0.47	0.47	0.47	0.47	0.47	0.47
		Sun.	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47

Table A.3. (contd)

Building Type	Peak Densities	Day of Week	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Retail	Lighting 1.88 W/ft^2	Weekday	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.32	0.61	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.71	0.71	0.61	0.32	0.18	0.18
		Sat.	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.22	0.39	0.65	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.56	0.39	0.39	0.22	0.18	0.18
		Sun.	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.22	0.45	0.60	0.60	0.60	0.60	0.60	0.45	0.29	0.18	0.18	0.18	0.18	0.18
	Plugs 0.4 W/ft^2	Weekday	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.38	0.65	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.74	0.74	0.65	0.38	0.25	0.25
		Sat.	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.29	0.44	0.67	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.59	0.44	0.44	0.29	0.25	0.25
		Sun.	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.28	0.47	0.60	0.60	0.60	0.60	0.60	0.47	0.35	0.25	0.25	0.25	0.25	0.25
Warehouse	Lighting 1.19 W/ft^2	Weekday	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.69	0.79	1.00	1.00	1.00	0.90	1.00	1.00	1.00	1.00	0.38	0.17	0.17	0.17	0.17	0.17	0.17
		Sat.	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
		Sun.	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
	Plugs 0.15 W/ft^2	Weekday	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.88	0.92	1.00	1.00	1.00	0.96	1.00	1.00	1.00	1.00	0.75	0.67	0.67	0.67	0.67	0.67	0.67
		Sat.	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67
		Sun.	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67

A major input in developing the 2015 estimates is the estimated market share of electronic versus magnetic fluorescent ballasts in 2015. This estimate was developed using the National Energy Savings model with 2027 base case (http://www.eren.doe.gov/buildings/codes_standards/applbrf/ballast.html LBNL NESv_4). This ballast model, along with an internal Ernest Orlando Lawrence Berkley National Laboratory (LBNL) spreadsheet developed to supplement the NES, were used to run a consensus standards scenario to estimate magnetic ballast shipments. In the internal spreadsheet, the magnetic ballasts projected by the NES model for each year (which go to zero by a certain year under the standard) were added to the ballasts in the existing stock. This 2027 base scenario is assumed to cover renovated buildings whose magnetic ballasts are removed at the fixture turnover rate (16 years). In the internal spreadsheet, the magnetic ballasts projected by the NES model for each year (which go to zero by a certain year under the standard) were added to the ballasts in the existing stock. A new building growth rate of 1.07 percent was assumed (based on projected commercial and industrial historical and floor space (including federal buildings) from 1980 to 2030, based on data developed by building type by Regional Economic Research, Inc. (RER), San Diego, California[a].

The results show (LBNL NESr-4) that by 2015, the magnetic ballasts are likely to comprise 30% of the total ballast market under the anticipated standards (4690 in the 2027 base case). Fluorescent systems represent 77% of lit floor space according to the 1995 CBECS (EIA 1995). Thus, we concentrated on fluorescent technology to capture most changes.

The interior space type models used in this derivation are those developed for the Standard 90.1-1999 lighting standards. These models are considered by lighting design professionals and practitioners to represent good quality and innovative lighting design. These models do not represent the mix of existing building lighting designs. However, with the current interest in good quality design and human factor effects of the workplace environment, this kind of design will probably dominate much of the building stock by 2015. By 2015, a portion (estimated up to 16%) of the building stock will consist of new buildings constructed with these design elements in mind. Further, a large portion of the existing building stock will also have been retrofit with partial or full redesign. This redesign would be caused primarily by the replacement of degraded 15+-year-old systems and building redesigns for other purposes such as new tenants and changing building space functions.

The Standard 90.1-1999 lighting standard models also include some specific characteristics considered appropriate for year 2015 estimation. These models incorporate the upper range of energy-efficient equipment and ignore equipment that is generally on the trailing edge of the market as it is replaced with newer more efficient and upgraded versions. The models use the current leading edge T8 fluorescent technology as the basis for all linear fluorescent applications. The current trend in the development of smaller, cheaper, better CFL products will soon lead building lighting design and retrofit towards the application of CFLs in most previous incandescent applications. The models automatically incorporate compact fluorescent technology wherever it is possible to replace incandescent systems. The

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(a) *Technical Support Document: Energy Efficiency Standards for Consumer Products: Fluorescent Lamp Ballast Proposed Rule*, January 2000. U.S. Department of Energy, http://www.eren.doe.gov/buildings/codes_standards/applbrf/ballast.html. Appendix B, Table B.34.

models also incorporate halogen (incandescent replacement) and small metal halide lamps (efficient for replacement in some fluorescent applications) where appropriate.

The impact of the controls was not considered. Because the installed wattage would not change, no data existed to support an estimate of the impact, and HVAC systems would likely be designed for the full lighting load (undimmed).

Building Type: Assembly

Discussion of Profile: Assembly includes museums, dance halls, auditoriums, gymnasiums, sports facilities, and churches. The typical assembly building lighting profile is hat-shaped. Peak lighting integrity in 2015 is estimated at 1.59 W/ft^2.

Metered data were not available for this building type.

Building Type: Education

Discussion of Profile: Education includes school buildings. The typical school building lighting profile is hat-shaped. Usually, the lights are either on or off in a school building. Note that school buildings include elementary schools that may be expected to operate from 8 a.m. to 5 p.m., secondary schools that may be expected to have significant extracurricular activities at night, and colleges and universities that may have evening classes. This building type is highly varied.

Measured peak load estimates range from 0.9 W/ft^2 to 2.3 W/ft^2, with most estimates falling between 1.4 W/ft^2 and 2.3 W/ft^2. Off-hour base-load estimates range from 0 W/ft^2 to 0. 1 W/ft^2, with 0. 1 W/ft^2 providing a representative average. The estimated peak lighting intensity in the year 2015 was 1.45 W/ft^2.

Building Type: Food Service

Discussion of Profile: The typical restaurant building lighting profile is hat-shaped, with all lights either on or off. The lights are on when food is being served. Obviously, a 24-hour restaurant will have a much different profile than a lunch counter that serves only breakfast and lunch.

Measured peak-load estimates range from 1.2 W/ft^2 to 2.0 W/ft^2. Off-hour base-load estimates range from 0.14 W/ft^2 to 0.8 W/ft^2. The estimated peak lighting intensity in the year 2015 was 1.75 W/ft^2.

Building Type: Lodging

Discussion of Profile: Lodging includes hotels, motels, resorts, barracks, and dormitories. A wide diversity of individual lighting systems are likely to exist, resulting in a low percentage of the total lights to be on at any one time, with some lights on all the time. More lights will be on in the evening, but lighting loads will occur all hours of the day, 7 days a week. The estimated peak lighting intensity in the year 2015 was 1.54 W/ft^2.

Metered data were not available for this building type.

Building Type: Office

Discussion of Profile: The typical office building lighting profile is the classic hat shape, with a single-peak period occurring for most of the working day and a lower off-hour period. The peak period is typically 6 to 10 hours in duration. A transition period between the peak and off-hour period is typically 1 to 3 hours, depending on occupant behavior and lighting control schemes. Office buildings are typically active Monday through Friday, with minimal activity on Saturdays and even less on Sundays.

Measured peak working day estimates range from 0.7 W/ft^2 to 1.9 W/ft^2, with most of the estimates falling in the range of 1.3 W/ft^2 to 1.5 W/ft^2. The base off-hour load estimates range from 0 W/ft^2 to 0.6 W/ft^2, with most metered estimates being in the range of 0.2 W/ft^2 to 0.4 W/ft^2. The estimated peak lighting intensity in the year 2015 was 1.32 W/ft^2.

Building Type: Retail

Discussion of Profile: The typical retail building lighting profile is hat-shaped. Usually, the lights in a retail building are on if the business is open and off if the business is closed. The peak period is typically 10 hours in duration. Retail buildings are typically active all days of the week, with reduced hours on Sundays.

Peak lighting load estimates range from 1.1 W/ft^2 to 2.9 W/ft^2, with metered results tending to fall in the lower part of the range. Off-hour base-load estimates range from 0 W/ft^2 to 0.3 W/ft^2, with metered data indicating 0. 1 W/ft^2 to 0.3 W/ft^2. The estimated peak lighting intensity in the year 2015 was 1.32 W/ft^2.

Building Type: Warehouse

Discussion of Profile: The typical warehouse building lighting profile is hat-shaped. Usually, the lights in a warehouse are on if the business is open and off if the business is closed. Weekends show minimal loads.

The peak load estimates range from 0.4 W/ft^2 to 0.7 W/ft^2 with most values falling near 0.6 W/ft^2. Off-hour base-load estimates range from 0 W/ft^2 to 0.2 W/ft^2, with 0.1 W/ft^2 representing a suitable average. The estimated peak lighting intensity in the year 2015 was 1.19 W/ft^2.

A.2.3 Plug Loads

Building Type: Assembly

Discussion of Profile: The typical assembly building plug load profile is hat-shaped.

Metered data were not available for this building type. The assumed peak and off-hour base loads for the screening analysis were 0.19 W/ft^2 and 0.01 W/ft^2, respectively.

Building Type: Education

Discussion of Profile: The typical education building plug load profile is hat-shaped.

Because the sample size for metered data was very small, the proposed Standard 90.1-1999 profiles and associated peak and off-hour base loads were used for the screening analysis. The peak and off-hour base loads for the screening analysis were 0.475 W/ft^2 and 0.01 W/ft^2, respectively.

Building Type: Food Service

Discussion of Profile: The typical food service building plug load profile is hat-shaped. Obviously, a 24-hour restaurant will have a much different profile than a lunch counter that serves only breakfast and lunch.

The ASHRAE peak and off-hour base-load values were used for this screening analysis. The peak and off-hour base loads for the screening analysis were 1.2 W/ft^2 and 0.5 W/ft^2, respectively.

Building Type: Lodging

Discussion of Profile: Lodging includes hotels, motels, resorts, barracks, and dormitories.

Metered data were not available for this building type. The ASHRAE peak and off-hour base-load values were used for this screening analysis. The peak and off-hour base loads for the screening analysis were 0.225 W/ft^2 and 0.1 W/ft^2, respectively.

Building Type: Office

Discussion of Profile: The typical office building plug load profile is the classic hat-shape, with a single-peak period occurring for most of the working day and a lower off-hour period. The peak period is typically 6 to 10 hours. A transition period between the peak and off-hour period is typically 1 to 3 hours, depending on occupant behavior. Office buildings are typically active Monday through Friday, with minimal activity on Saturdays and even less on Sundays.

Peak-load estimates range from 0.2 W/ft^2 to 0.8 W/ft^2, with most falling in the range of 0.6 W/ft^2 to 0.8 W/ft^2. Off-hour base-load estimates range from 0 W/ft^2 to 0.4 W/ft^2, with many falling near 0.3 W/ft^2. The peak and off-hour base loads for the screening analysis were 0.64 W/ft^2 and 0.3 W/ft^2, respectively.

Building Type: Retail

Discussion of Profile: The typical retail building plug profile is hat-shaped.

Peak-load estimates range from 0.2 W/ft^2 to 0.6 W/ft^2. Off-hour base loads range from 0 W/ft^2 to 0.2 W/ft^2. The peak and off-hour base loads for the screening analysis were 0.4 W/ft^2 and 0.1 W/ft^2, respectively.

Building Type: Warehouse

Discussion of Profile: The typical warehouse building plug load profile is hat-shaped.

Metered data indicate that relatively little difference exists between the peak and off-hour base plug loads in a warehouse, so the peak and off-hour base loads for the screening analysis were 0.15 W/ft^2 and 0.1 W/ft^2, respectively.

A.3 Building HVAC Operation and Occupancy Assumptions

A.3.1 General Assumptions for Building Modeling

The 1992 CBECS (EIA 1992) has a survey question that asks whether the building has extra heating and cooling hours[a] (in addition to the normal operating hours of the building). The available responses are "yes," "no," or "inapplicable." Another question asks if there is a reduction in cooling off-hours, and a final question asks how many extra hours of heating and cooling are incurred beyond the (reported) operating hours. The average extra hours of operation per week (averaged by weighted square footage) were computed in the analysis.

Ventilation rates should be based on expected maximum occupancy (not the profile peak values used here) for internal load assumptions (ASHRAE 1989b).

Standard 90.1-1989 schedules and occupancy densities referred to in this appendix are from the proposed Addendum 90.1j.

Tables A.4 and A.5 show the HVAC operation schedules and occupancy schedule for weekdays, weekends, and holidays, respectively, for each representative building type. These schedules and the source from which they were derived are described in the following section.

A.3.2 Assembly Building Assumptions

HVAC Operation Schedule – The CBECS (EIA 1992) reported 18 extra hours of HVAC operation per week, in addition to the normal operating hours of the building. However, only 10 extra hours were determined by adding 5 hours to the Saturday and Sunday occupancy schedules but none to the weekday occupancy schedule because 24-hour operation on weekdays was assumed.

Saturday and Sunday Occupancy Schedule - Based on square footage (or weighted average), the building is typically closed on Saturday and Sunday. The second most prevalent schedule is open 24

(a) The 1995 CBECS data did not have this information; therefore, 1992 CBECS data were used to extract the extra occupancy information (EIA 1992, 1995).

hours. Other than 0- or 24-hour operation, 12-hour operation was the most typical (based on the sample's sum of the square footage). Operating hours were assumed to be 11 a.m. to 11 p.m. ASHRAE used noon

Table A.4. HVAC Operation Schedules

Building Type	Day of Week	Hour On	Hour Off
Assembly	Weekday	----- On -----	
	Saturday	0600	2300
	Sunday	0600	2300
	Holiday	0600	2300
Education	Weekday	0600	2300
	Saturday	1000	1500
	Sunday	----- Off ----	
	Holiday	----- Off -----	
Food Service	Weekday	0700	0300
	Saturday	0700	0300
	Sunday	0700	0300
	Holiday	0700	0300
Lodging	Weekday	----- On ----	
	Saturday	----- On ----	
	Sunday	----- On ----	
	Holiday	----- On ----	
Office	Weekday	0600	2300
	Saturday	0900	1600
	Sunday	----- Off ----	
	Holiday	----- Off ----	
Retail	Weekday	0800	2300
	Saturday	0800	2300
	Sunday	1000	2000
	Holiday	1000	2000
Warehouse	Weekday	----- On ----	
	Saturday	----- Off ----	
	Sunday	----- Off ----	
	Holiday	----- Off ----	

to 10 p.m. full occupancy and 11 p.m. to 9 a.m. partial occupancy. The ASHRAE schedule was adjusted to have 12 hours of operation. Sunday was modeled the same as Saturday.

Weekday Occupancy Schedule – The CBECS (EIA 1992) reported 24-hour operation as the most prevalent schedule. Twenty-four hours were assumed using the ASHRAE occupancy shape for weekdays, but inflating the nighttime period occupancy to 10%. The HVAC system was assumed to run 24 hours because the buildings were occupied for the whole period (although at reduced levels).

Occupant Density - Assumptions were based on the proposed Addendum 90.1j data with maximum occupancy numbers from Standard 62-1989 (ASHRAE 1989b) and the Uniform Building Code (UBC) (ICBO 1994). For assembly, good data were lacking so the Standard 90.1-1989 data were normalized to 100% (ASHRAE's 80% peak were not used).

A.3.3 Education Building Assumptions

HVAC Operation Schedule – The CBECS (EIA 1992) reported 20 extra hours of HVAC operation per week. Two hours were added before operation and 1 hour after operation, Monday through Friday. For Saturday, HVAC was assumed to be on for 5 hours [no occupancy is reported, but one person in the whole building on Saturday is too small to quantify; however, that person probably turns the HVAC system on (e.g., janitor, pastor)].

Saturday and Sunday Occupancy Schedule - CBECS (EIA 1992) and ELCAP both reported that most education buildings (by square feet and number of buildings) are closed on Saturday and Sunday. Addendum 90.1j showed they are open 5 hours on Saturday, which were eliminated.

Weekday Occupancy Schedule - CBECS (EIA 1992) reported that most education buildings are open from 7 a.m. to 10 p.m., with 7 a.m. to 4 p.m. close behind. ELCAP reported 8 a.m. to 10 p.m. and 7 a.m. to 4:30 p.m. as the most common open hours. Obviously, whether or not the education building is used at night is a factor (e.g., adult school, universities). The Addendum 90.1j schedule was used because it already showed the major load from 8 a.m. to 4 p.m., with another partial load in the evening and from 7 a.m. to 8 a.m.

Occupant Density - An assumption of 90 ft^2 per person average daily peak was used. Assumptions were based on ELCAP and CBECS (EIA 1992) data, with maximum occupancy numbers from Standard 62-1989 (ASHRAE 1989b) and the UBC (ICBO 1994). ELCAP reported the average peak as 120 ft^2 per person and CBECS reported 93 ft^2 per seat. The Addendum 90.1j schedule had a daily peak of 83.3 ft^2 per person.

A.3.4 Food Service Building Assumptions

HVAC Operation Schedule - CBECS (EIA 1992) reported 17 extra hours of HVAC operation per week. More extra hours were used because occupants are present (cooks, preps, cleaners) for many hours when the business is closed. The HVAC system remains on during all the hours the building is occupied.

Saturday Occupancy Schedule - CBECS (EIA 1992) reported that most food service buildings are open 12 to 14 hours on Saturday, typically from 11 a.m. to 1 a.m. ELCAP reported they are typically open from 9 a.m. to 2 a.m. Addendum 90.1j showed typical hours open from 10 a.m. to 2 a.m. The ASHRAE schedule was modified to open at the same time but close an hour early. Additional occupants were added before and after the business is open to account for prep work and cleanup (2% to 5% of occupants during closed hours).

Table A.5. Occupancy Schedules for BLAST Runs (fraction of weekday peak occupancy)

Building Type	Peak Occupancy	Day of Week	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Assembly	0.016 people/ft^2	Weekday	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.29	0.29	0.29	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.29	0.29	0.29	0.29	0.17	0.05
		Sat.	10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.75	0.75	0.75	0.75.	0.75	0.75	0.75	0.75	0.75	1.00	0.25	0.00	0.00
		Sun.	10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.13	0.13	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.25	0.00	0.00
Education	0.0107 people/ft^2	Weekday	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.83	1.00	1.00	0.89	0.89	0.89	0.89	0.50	0.17	0.06	0.17	0.22	0.22	0.11	0.00	0.00
		Sat.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Sun.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Food Service	0.011 people/ft^2	Weekday	0.11	0.02	0.00	0.00	0.00	0.00	0.02	0.02	0.05	0.05	0.22	0.54	0.86	0.76	0.43	0.22	0.27	0.54	0.86	0.86	0.86	0.54	0.38	0.22
		Sat.	0.33	0.02	0.00	0.00	0.00	0.00	0.02	0.02	0.06	0.06	0.22	0.56	0.56	0.56	0.39	0.33	0.33	0.33	0.78	1.00	0.78	0.72	0.61	0.39
		Sun.	0.22	0.02	0.00	0.00	0.00	0.00	0.02	0.02	0.06	0.06	0.22	0.56	0.56	0.56	0.39	0.33	0.33	0.33	0.78	1.00	0.78	0.39	0.22	0.22
Lodging	0.0033 people/ft^2	Weekday	1.00	1.00	1.00	1.00	1.00	1.00	0.77	0.43	0.43	0.20	0.20	0.20	0.20	0.20	0.20	0.31	0.54	0.54	0.54	0.77	0.77	0.89	1.00	1.00
		Sat.	1.00	1.00	1.00	1.00	1.00	1.00	0.77	0.53	0.53	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.53	0.65	0.65	0.65	0.77	0.77	0.77
		Sun.	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.54	0.54	0.54	0.31	0.31	0.20	0.20	0.20	0.31	0.43	0.43	0.66	0.66	0.88	0.88	0.88
Office	0.0033 people/ft^2	Weekday	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.21	1.00	1.00	1.00	1.00	0.53	1.00	1.00	1.00	1.00	0.32	0.11	0.11	0.11	0.11	0.05	0.05
		Sat.	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.05	0.05	0.00	0.00	0.00	0.00	0.00
		Sun.	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00
Retail	0.0022 people/ft^2	Weekday	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.25	0.63	0.88	0.88	0.88	0.88	1.00	0.88	0.63	0.63	0.38	0.38	0.13	0.00	0.00
		Sat.	0.00	0.00	0.00	0.00	0 00	0.00	0 00	0.00	0.13	0.25	0.75	1.00	1.00	1.00	1.00	1.00	0.75	0.25	0.25	0.25	0.13	0.00	0.00	0.00
		Sun.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.25	0.50	0.50	0.50	0.50	0.50	0.25	0.13	0.00	0.00	0.00	0.00	0.00
Warehouse	0.0003 people/ft^2	Weekday	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.21	0.79	1.00	1.00	1.00	0.58	0.95	0.95	0.95	0.26	0.10	0.10	0.10	0.10	0.10	0.10	0.10
		Sat.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Sun.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Sunday Occupancy Schedule - CBECS (EIA 1992) reported that most food service buildings are open 14 hours on Sunday, typically from 11 a.m. to 1 a.m. ELCAP reported they are typically open from 11 a.m. to 11 p.m. Addendum 90.1j showed typical hours open from 11 a.m. to 2 a.m. The ASHRAE schedule was modified to open at the same time but close an hour early, with additional occupants before and after the business is open to account for prep work and cleanup (2% to 5% of occupants during closed hours).

Weekday Occupancy Schedule - CBECS (EIA 1992) reported that most food service buildings are open 12 to 14 hours on weekdays, typically from 11 a.m. to 1 a.m. ELCAP reported they are typically open from 9 a.m. to midnight. Addendum 90.1j showed typical hours open from 10 a.m. to 2 a.m. The ASHRAE schedule was modified to open at the same time but close an hour early, with additional occupants before and after the business is open to account for prep work and cleanup (2% to 5% of occupants during closed hours).

Occupant Density - Assumptions were based on ELCAP and CBECS (EIA 1992) data, with maximum occupancy numbers from Standard 62-1989 (ASHRAE 1989b) and the UBC (ICBO 1994). ELCAP reported 110 ft^2 per person on weekdays and 75-95 ft^2 per person on weekends. CBECS reported 42 ft^2 per seat (1/3 of seats are empty at normal weekday peak). Addendum 90.lj showed 125 ft^2 per person.

A.3.5 Lodging Building Assumptions

HVAC Operation Schedule - CBECS (EIA 1992) reported three extra hours of HVAC operation per week, but because the buildings are occupied 24 hours a day, 7 days a week, this amount of time did not mean anything (no setback schedule).

Occupancy Schedule - CBECS (EIA 1992) reported 24-hour operation every day—the same as Standard 90.1-1989. The schedule remained identical to the proposed Addendum 90.1j.

Occupant Density - An assumption of 300 ft^2 per person was based on ELCAP and CBECS data, with maximum occupancy numbers from Standard 62-1989 (ASHRAE 1989b) and the UBC (ICBO 1994). ELCAP reported 300 ft^2 per person and CBECS reported 565 ft^2 per room (appx. 1.9 persons per room) for weekdays (peak). Addendum 90.1j had 278 ft^2 per person.

A.3.6 Office Building Assumptions

HVAC Operation Schedule – CBECS (EIA 1992) reported 30 extra hours of HVAC operation per week. To match the occupancy schedule, 7 hours/day, Monday through Friday, were added plus 7 hours on Saturday (again, the HVAC system is probably scheduled on Saturdays for the one or two people who come in even though the schedule says 0 occupants) (see Table A.6).

Saturday and Sunday Occupancy Schedule - CBECS (EIA 1992) and ELCAP reported that most buildings are closed on Saturday and Sunday. CBECS (EIA 1992) reported 20% of office space open on

Saturday from 8 a.m. to 1 p.m. The Addendum 90.1j schedule was used but matched to plug loads. Occupancy density on Saturday was dropped to only 10%.

Weekday Occupancy Schedule - CBECS (EIA 1992) and ELCAP both reported hours of operation as 8 a.m. to 6 p.m. The Addendum 90.1j schedule was used but matched to the plug schedule for ramps.

Occupant Density - Assumptions were based on ELCAP and CBECS (EIA 1992) data, with maximum occupancy numbers from Standard 62-1989 (ASHRAE 1989b) and the UBC (ICBO 1994). CBECS (EIA 1992) reported 760 ft^2 per person and ELCAP reported 875 ft^2 per person as the average daily peaks. Addendum 90.1 uses 290 ft^2 per person as the average daily peak. A typical office or cubicle space is about 15 x 10 ft and usually contains one to two people. Adding 3 ft of hallway still equals less than 200 ft^2 per person. Adding restroom area, conference rooms, broom closets, and warehouse space may add another 50 to 100 ft^2 per person, which is still low compared to the numbers reported in CBECS (EIA 1992) and ELCAP. This low value may be because small office buildings generally hold multiple businesses, so the occupant density is much lower (e.g., real estate agencies, insurance offices, accountants). These buildings also have a lot more area that is not associated with office space (e.g., lobbies, wider hallways).

A.3.7 Retail Building Assumptions

HVAC Operation Schedule - CBECS (EIA 1992) reported 27 extra hours of HVAC operation per week. Three hours before and 1 hour after operating hours, 7 days a week, were added.

Saturday Occupancy Schedule - CBECS (EIA 1992) reported that most retail buildings are open from 10 a.m. to 9 p.m. on Saturday. The extremes of 24-hour operation and closed are tied for a close second. ELCAP reported typical retail hours from 9 a.m. to 6 p.m. on Saturday. The Addendum 90.1j schedule was used with a shorter schedule (deleted 8 a.m. and cut back percent occupancy at 9 a.m. and 10 a.m.).

Sunday Occupancy Schedule - CBECS (EIA 1992) and ELCAP both reported that most (CBECS 64%) retail stores are closed on Sunday. On a square foot basis, most retail stores surveyed were open on Sunday from noon to 5 or 6 p.m. The Addendum 90.1j schedule was used with an hour deleted at 10 a.m. and a reduction in the number of occupants at 11 a.m.

Weekday Occupancy Schedule - CBECS (EIA 1992) reported that most retail stores are open from 10 a.m. to 9 p.m. on weekdays. ELCAP reported they are typically open from 9 a.m. to 9 p.m. The Addendum 90.1j schedule was used with occupancy deleted at 8 a.m. and the number of occupants reduced at 9 a.m., 10 a.m., and 10 p.m.

Occupant Density - Assumptions were based on ELCAP and CBECS (EIA 1992) data, with maximum occupancy numbers from Standard 62-1989 (ASHRAE 1989b) and the UBC (ICBO 1994). ELCAP shows 450 ft^2 per person as the average daily peak on Monday through Saturday and 190 ft^2 per person as the average daily peak on Sunday. CBECS reports only employee density; thus, this data is inappropriate for occupant density. Addendum 90.1j shows 375 ft^2 per person as the average daily peak

(Monday through Saturday). Note that ELCAP reported more occupants on Sunday than Monday through Saturday, but the Addendum 90.1j schedule has fewer occupants on Sunday than Monday through Saturday.

A.3.8 Warehouse Building Assumptions

HVAC Operation Schedule - CBECS (EIA 1992) reported 18 extra hours of HVAC operation per week. No extra hours were added because the warehouse is assumed to be operating 24 hours per day, Monday through Friday, with no occupants on Saturday through Sunday.

Saturday and Sunday Occupancy Schedule - CBECS (EIA 1992) and ELCAP reported that most warehouse buildings are closed on Saturday and Sunday. Addendum 90.1j showed open hours on Saturday that were eliminated.

Weekday Occupancy Schedule - CBECS (EIA 1992) reported that most warehouses are open 24 hours, Monday through Friday. ELCAP reported they are typically open 8 a.m. to 5 p.m. Addendum 90.1j showed open hours from 7 a.m. to 5 p.m. This time span (7 a.m. to 5 p.m.) was left the same with an additional 5% occupancy added all night.

Occupant Density - An assumption of 3260 ft^2 per person was used. Assumptions were based on ELCAP and CBECS (EIA 1992) data, with maximum occupancy numbers from Standard 62-1989 (ASHRAE 1989b) and the UBC (ICBO 1994). ELCAP reported 1700 ft^2 per person and CBECS reported 4820 ft^2 per person. The average of the two surveys was used. Addendum 90.1j showed 16,667 ft^2 per person, which is extremely different from the survey results.

A.4 Occupant Activity Levels

For the BLAST loads calculations, the occupant activity level was assumed to be 425 Btu/h per person for all building types except food services and warehouses. For food services, the activity level was assumed to be 550 Btu/h per person. For warehouses, the activity level was 1,000 Btu/h per person. These values were derived from data in the *ASHRAE 1993 Handhook: Fundamentals* (ASHRAE 1993). The occupant activity levels were not varied with climate location.

A.5 Outdoor-Air Ventilation

The ventilation values for the outdoor-air requirement per person came from *ASHRAE Standard 62-1989*, Table A.2 (ASHRAE 1989b). Table A.6 summarizes the peak occupancy and the ventilation rates derived to meet the peak occupancy. BLAST simulations require that the ventilation requirement be provided as a fraction of the total supply airflow rate. Using the total building design supply airflow rate that was estimated by the BLAST simulation and the required ventilation flow that would satisfy peak occupancy, the fraction of the outdoor-air requirement was estimated for each climate location. The design supply airflow rate changes by zone and by climate location. To show the variation in outdoor-air percent change by location and building, the mean, minimum, and maximum outdoor-air percent for each of the seven representative building types are summarized in Table A.6.

Table A.6. Ventilation Rates for BLAST Runs

Building Type	Occupancy (ft^2/person)	Occupancy (people/ft^2)	Outdoor-Air Requirement (cfm/person)	Outdoor-Air Requirement Mean (%)	Outdoor-Air Requirement Low (%)	Outdoor-Air Requirement High (%)
Assembly	62.5	0.0160	15	53	46	59
Education	90	0.0160	15	38	26	47
Food Service	91	0.0111	20	38	34	42
Lodging	300	0.0110	15	14	13	16
Office	91	0.0033	20	17	14	20
Retail	450	0.0110	15	8	6	9
Warehouse	3,260	0.0022	--	2	1	2

A.6 Windows

The office, assembly, and food service building types have double-pane glazing with blinds (R=1.45, SC=0.58). Retail has single-pane glazing without blinds (R=0.50, SC=0.95), and all other building types have single-pane with blinds (R=0.50, SC=0.67). The assumptions for window variations by building type came from an analysis of CBECS data (EIA 1992). The thermal properties for single- and double-pane windows were obtained from the *1993 ASHRAE Handbook: Fundamentals,* pages 27.36 and 27.6 (ASHRAE 1993).

CBECS (EIA 1992) data were used to calculate window-to-wall ratios (WWRs) for the buildings based on census region (DOC 1997). For the BLAST runs, these WWRs were expressed as a window height value. The calculation was based on a floor height of 13 ft and a wall length of 100 ft (for the generic prototype building). The window is 99 ft in length, and the height is based on the WWR. The equation is

$$\text{WHEIGHT} = 13 \text{ x } 100 \text{ x } \frac{\text{WWR}}{99} \tag{A.1}$$

Table A.7 lists the WWR assumptions for each building type and census region.

A.7 Walls and Roofs/Ceilings

CBECS (EIA 1992) data indicated that masonry walls and built-up roofs are the norms for the commercial building types considered (see Tables A.8 and A.9). The default insulation thickness corresponding to R-11 for all exterior walls and R- 13 for built-up roofs was assumed. A correction factor has been applied to the nominal R-values for the walls. This factor accounts for the reduction in thermal resistance caused by metal stud construction. The factor was determined to be 0.58 and thus the wall insulation R-value is 6.41 (11 x 0.58).

Table A.7. Window-to-Wall Ratios Assumed for Building Types in Each Census Region

Building Type	R1	R2	R3	R4
Assembly	0.20	0.10	0.10	0.10
Education	0.40	0.20	0.10	0.10
Food Service	0.20	0.10	0.10	0.20
Lodging	0.20	0.20	0.20	0.20
Office	0.20	0.10	0.10	0.20
Retail	0.10	0.10	0.10	0.10
Warehouse	0.10	0.10	0.10	0.10
R1 - Providence R2 - Minnesota, Detroit R3 - Knoxville, Shreveport, Orlando R4 - Denver, Seattle, Los Angeles, Phoenix, Fresno.				

Table A.8. Thermal Characteristics of Walls

Wall Insulation R-Value (h·ft^2/(°F·Btu)	6.41
Total Wall R-Value (h·ft^2/°F·Btu)	7.42
Wall Mass (lb/ft^2)	47.94

Table A.9. Thermal Characteristics of Roofs

Roof Insulation R-Value (h·ft^2/°F·Btu)	13.26
Total Roof R-Value (h·ft^2/°F·/Btu)	14.53
Roof Mass (lb/ft^2)	6.42

The analysis assumed the wall construction to have an exterior surface with a 4-in. brick facing (see Table A.8). The use of a more massive wall has a slight impact on reducing the building shell load through the opaque wall section.

A.8 Infiltration

Two infiltration schedules were used—one for interior and one for exterior for each building type. The interior schedules had zero outdoor air during periods when the building's HVAC system was scheduled to be off, which were applied to the core zones. The exterior schedules had an infiltration value of 49.4 cfm (for the generic prototype with 1,500 ft^2 perimeter zones) when the HVAC system was off. This value was based on 0.038 cfm/ft^2 in Standard 90.1-1989, Section 13.7.3.2 (ASHRAE 1989a).

A.9 FLEOH and Weights Used for the Screening Analysis

FLEOH for cooling and heating and for various combinations of BLAST runs are tabulated in this section (see Tables A.10–A.16). In addition to FLEOH, the weights used to aggregate various combinations of cooling and heating FLEOH are also tabulated. FLEOH for each combination are presented as a function of the 11 climate locations and 7 building types.

Table A.10. Cooling FLEOH Without Economizer and Temperature Setback/Setup

	Assembly	Education	Food Service	Lodging	Office	Retail	Warehouse
Providence	1066	873	1559	1210	1284	1410	1043
Detroit	987	749	1455	1105	1199	1327	939
Minneapolis	1080	828	1517	1183	1232	1284	1077
Knoxville	1751	1304	2431	1917	1959	2176	1520
Shreveport	2269	1699	2993	2492	2439	2721	1792
Orlando	3184	2373	4062	3425	3259	3593	2370
Denver	1197	906	1763	1434	1521	1568	1322
Phoenix	2884	2314	3653	3238	3108	3500	2675
Seattle	798	579	1437	925	1169	1320	1237
Fresno	1926	1558	2646	2274	2277	2615	1848
Los Angeles	1692	1224	2859	2013	2203	2554	1407

Table A.11. Cooling FLEOH With Economizer and Temperature Setback/Setup

	Assembly	Education	Food Service	Lodging	Office	Retail	Warehouse
Providence	876	611	1088	842	778	886	439
Detroit	837	548	1043	765	739	834	407
Minneapolis	929	630	1117	828	801	867	505
Knoxville	1575	1059	1950	1560	1371	1523	1045
Shreveport	2104	1403	2507	2162	1788	1966	1418
Orlando	3016	1982	3499	3108	2493	2771	2040
Denver	1011	701	1197	956	904	982	531
Phoenix	2674	1864	3019	2763	2231	2456	2069
Seattle	526	338	638	383	455	493	157
Fresno	1685	1222	1976	1698	1504	1722	1199
Los Angeles	1128	762	1502	898	1147	1314	322

Table A.12. Cooling FLEOH With Economizer and Without Temperature Setback/Setup

	Assembly	Education	Food Service	Lodging	Office	Retail	Warehouse
Providence	875	673	1114	842	868	939	537
Detroit	832	596	1055	765	811	883	480
Minneapolis	923	673	1136	828	873	901	627
Knoxville	1581	1157	2018	1560	1570	1703	1082
Shreveport	2111	1566	2604	2162	2083	2271	1486
Orlando	3032	2240	3703	3108	2956	3236	2131
Denver	999	722	1192	956	938	965	641
Phoenix	2691	2104	3155	2763	2567	2822	2236
Seattle	519	340	634	383	442	474	305
Fresno	1671	1310	1997	1698	1667	1865	1261
Los Angeles	1111	770	1484	898	1179	1372	514

Table A.13. Cooling FLEOH Without Economizer and With Temperature Setback/Setup

	Assembly	Education	Food Service	Lodging	Office	Retail	Warehouse
Providence	1059	773	1523	1210	1118	1297	952
Detroit	983	676	1430	1105	1041	1216	862
Minneapolis	1077	758	1488	1183	1081	1199	966
Knoxville	1739	1173	2360	1917	1689	1941	1488
Shreveport	2252	1504	2882	2492	2065	2360	1739
Orlando	3157	2083	3832	3425	2724	3059	2291
Denver	1193	829	1749	1434	1347	1468	1230
Phoenix	2850	2001	3487	3238	2602	2903	2541
Seattle	797	540	1435	925	1059	1293	1123
Fresno	1914	1386	2572	2274	1971	2282	1816
Los Angeles	1687	1139	2836	2013	1934	2359	1313

Table A.14. Heating FLEOH With Temperature Setback/Setup

	Assembly	Education	Food Service	Lodging	Office	Retail	Warehouse
Providence	1894	795	1388	1523	504	454	740
Detroit	2037	901	1597	1683	615	540	894
Minneapolis	1967	941	1564	1699	681	589	1125
Knoxville	1483	634	1197	973	340	212	332
Shreveport	1075	422	774	559	204	71	50
Orlando	638	240	509	234	136	16	497
Denver	1833	783	1282	1336	436	340	561
Phoenix	966	317	722	349	176	16	22
Seattle	2427	1070	1697	1784	583	370	743
Fresno	1568	592	1057	779	257	98	54
Los Angeles	1267	508	866	468	200	29	0

Table A.15. Heating FLEOH Without Temperature Setback/Setup

	Assembly	Education	Food Service	Lodging	Office	Retail	Warehouse
Providence	1927	1272	1269	1523	972	1207	1074
Detroit	2067	1382	1458	1683	1143	1341	1216
Minneapolis	1995	1386	1528	1699	1243	1417	1428
Knoxville	1491	891	987	973	572	641	508
Shreveport	1074	565	575	559	299	282	101
Orlando	628	271	222	234	131	39	1318
Denver	1855	1158	1173	1336	814	976	792
Phoenix	961	370	398	349	188	95	77
Seattle	2453	1599	1477	1784	1040	1148	1210
Fresno	1567	783	782	779	390	390	140
Los Angeles	1264	572	434	468	205	159	0

The weights that are tabulated in this section were derived from the CBECS database (EIA 1995). There are four sets of weights for the cooling products (Tables A.16 through A.19) and only two sets of weights for the heating products (Tables A.20 and A.21).

Table A.16. Fraction of Building Stock Without Economizers and Setback/Setup – Cooling Analysis

	Assembly	Education	Food Service	Lodging	Office	Retail	Warehouse
New England	0	0	0	0	0	0	0.227405
Middle Atlantic	0	0	0	0	0	0	0.076886
East North Central	0.005375	0	0	0	0	0.006694	0.258959
West North Central	0.033255	0	0	0	0	0.007742	0.172003
South Atlantic	0.08702	0	0	0	0	0.005462	0.193529
East South Central	0	0	0	0	0	0.002834	0.363772
West South Central	0.002634	0	0	0	0	0.011654	0.212309
Mountain North	0	0	0	0	0	0.02884	0.126202
Mountain South	0	0	0	0	0	0.02884	0.126202
Pacific North	0.002397	0	0.113878	0	0	0.048839	0.025829
Pacific South	0.002397	0	0.113878	0	0	0.048839	0.220804

Table A.17. Fraction of Building Stock With Economizers and Without Setback/Setup – Cooling Analysis

	Assembly	Education	Food Service	Lodging	Office	Retail	Warehouse
New England	0	0.04357	0	1	0.17546	0.039801	0.181893
Middle Atlantic	0.397417	0.101377	0	0.915039	0.331983	0.155249	0.359142
East North Central	0.195692	0.101478	0.160354	0.960406	0.26397	0.099795	0.236753
West North Central	0.148188	0.009308	0.7787	0.97927	0.365021	0.237726	0.327376
South Atlantic	0.290774	0.086204	0.259135	0.895641	0.23351	0.133141	0.162281
East South Central	0.395539	0.075002	0.534163	0.915401	0.243597	0.229179	0.139533
West South Central	0.187606	0.056535	0.027451	1	0.211972	0.158675	0.218878
Mountain North	0.156179	0.078664	0	0.961944	0.1178	0.17659	0.050391
Mountain South	0.156179	0.078664	0	0.961944	0.1178	0.17659	0.050391
Pacific North	0.186046	0.064038	0.145197	0.900177	0.12675	0.089767	0.275024
Pacific South	0.186046	0.064038	0.145197	0.900177	0.12675	0.089767	0.219979

Table A.18. Fraction of Building Stock Without Economizers and With Setback/Setup – Cooling Analysis

	Assembly	Education	Food Service	Lodging	Office	Retail	Warehouse
New England	0	0	0	0	0	0	0
Middle Atlantic	0	0	0	0	0	0	0
East North Central	0	0	0	0	0	0	0
West North Central	0	0	0	0	0	0	0
South Atlantic	0	0	0	0	0	0	0
East South Central	0	0	0	0	0	0	0
West South Central	0	0	0	0	0	0	0
Mountain North	0	0	0	0	0	0	0
Mountain South	0	0	0	0	0	0	0
Pacific North	0	0	0	0	0	0	0
Pacific South	0	0	0	0	0	0	0

Table A.19. Fraction of Building Stock With Economizers and Setback/Setup – Cooling Analysis

	Assembly	Education	Food Service	Lodging	Office	Retail	Warehouse
New England	1	0.95643	1	0	0.82454	0.960199	0.590702
Middle Atlantic	0.602583	0.898623	1	0.084961	0.668017	0.844751	0.563972
East North Central	0.798933	0.898522	0.839646	0.039594	0.73603	0.893511	0.504288
West North Central	0.818556	0.990692	0.2213	0.02073	0.634979	0.754532	0.500621
South Atlantic	0.622206	0.913796	0.740865	0.104359	0.76649	0.861397	0.64419
East South Central	0.604461	0.924998	0.465837	0.084599	0.756403	0.767987	0.496694
West South Central	0.80976	0.943465	0.972549	0	0.788028	0.829671	0.568813
Mountain North	0.843821	0.921336	1	0.038056	0.8822	0.79457	0.823407
Mountain South	0.843821	0.921336	1	0.038056	0.8822	0.79457	0.823407
Pacific North	0.811558	0.935962	0.740925	0.099823	0.87325	0.861394	0.699147
Pacific South	0.811558	0.935962	0.740925	0.099823	0.87325	0.861394	0.559217

Table A.20. Fraction of Building Stock With Setback/Setup– Heating Products

	Assembly	Education	Food Service	Lodging	Office	Retail	Warehouse
New England	0.899638	0.95643	1	0	0.801262	0.948773	0.552156
Middle Atlantic	0.602583	0.886399	1	0.084961	0.636653	0.808539	0.557316
East North Central	0.741131	0.869464	0.839646	0.039594	0.687428	0.857392	0.501934
West North Central	0.818556	0.979782	0.2213	0.02073	0.61377	0.754532	0.457961
South Atlantic	0.622206	0.870386	0.6234	0.104359	0.714314	0.822677	0.503342
East South Central	0.604461	0.924998	0.465837	0.084599	0.756403	0.692815	0.496257
West South Central	0.80976	0.943465	0.972549	0	0.777809	0.816601	0.552062
Mountain North	0.823532	0.914379	1	0.038056	0.870798	0.765534	0.816463
Mountain South	0.823532	0.914379	1	0.038056	0.870798	0.765534	0.816463
Pacific North	0.789113	0.935962	0.710998	0.089078	0.871074	0.671133	0.531521
Pacific South	0.789113	0.935962	0.710998	0.089078	0.871074	0.671133	0.531521

Table A.21. Fraction of Building Stock With Setback/Setup– Heating Products

	Assembly	Education	Food Service	Lodging	Office	Retail	Warehouse
New England	0.100362	0.04357	0	1	0.198738	0.051227	0.447844
Middle Atlantic	0.397417	0.113601	0	0.915039	0.363347	0.191461	0.442684
East North Central	0.258869	0.130536	0.160354	0.960406	0.312572	0.142608	0.498066
West North Central	0.181444	0.020218	0.7787	0.97927	0.38623	0.245468	0.542039
South Atlantic	0.377794	0.129614	0.3766	0.895641	0.285686	0.177323	0.496658
East South Central	0.395539	0.075002	0.534163	0.915401	0.243597	0.307185	0.503743
West South Central	0.19024	0.056535	0.027451	1	0.222191	0.183399	0.447938
Mountain North	0.176468	0.085621	0	0.961944	0.129202	0.234466	0.183537
Mountain South	0.176468	0.085621	0	0.961944	0.129202	0.234466	0.183537
Pacific North	0.210887	0.064038	0.289002	0.910922	0.128926	0.328867	0.468479
Pacific South	0.210887	0.064038	0.289002	0.910922	0.128926	0.328867	0.468479

For the packaged boiler analyses, the FLEOHs were adjusted to account for the standby losses. Standby losses only occur when the boiler is in a hot standby condition. The length of the heating season and building-specific operational requirements dictate the number of days in a year the boiler is in a hot standby condition. For this analysis, the criterion specified in the *1998 ASHRAE Handbook: Fundamentals* was used to decide the number of days the boiler is available or in a hot standby condition (ASHRAE 1998). The number of days the boiler is available and the standby loss correction factors for each climate location and building type are tabulated in Table A.22. The heating FLEOHs are multiplied by these correction factors when analyzing the packaged boiler products.

Table A.22. Standby Loss Correction Factor for Packaged Boilers

Climate Location	Number of Days Boiler Is Available	Assembly	Education	Food Service	Lodging	Office	Retail	Warehouse
Providence	195	1.07	1.13	1.13	1.10	1.19	1.18	1.16
Detroit	180	1.05	1.11	1.10	1.08	1.14	1.14	1.12
Minneapolis	195	1.07	1.12	1.10	1.09	1.14	1.14	1.11
Knoxville	150	1.07	1.15	1.13	1.13	1.26	1.32	1.28
Shreveport	150	1.12	1.27	1.26	1.27	1.55	2.00	2.00
Orlando	60	1.06	1.22	1.25	1.26	1.50	2.00	2.00
Denver	195	1.08	1.15	1.15	1.13	1.24	1.23	1.23
Phoenix	90	1.06	1.24	1.21	1.26	1.52	2.00	2.00
Seattle	180	1.04	1.09	1.09	1.07	1.16	1.19	1.12
Fresno	180	1.06	1.18	1.16	1.18	1.41	1.84	2.00
Los Angeles	60	1.01	1.08	1.10	1.10	1.30	2.00	2.00

A.10 Representative Building Size and Shape

The building and equipment coil loads for the screening analysis were estimated using the generic building approach similar to the approach used for the Phase-I analysis (Barwig et al. 1996). This appendix provides a brief description of the approach and assumptions.

The coil loads simulated using the BLAST hourly simulation tool (BLAST 1991) are based on a generic 3-story, 15-zone building with specific building characteristics from the seven representative buildings types selected for the screening analysis. The generic building used for the simulation was a 48,000 ft^2, 3-story building with 5 zones per floor. In addition, the aspect ratio and perimeter depth were assumed to be 1:1 and 15 ft, respectively.

Several reasons exist to use a generic building approach to estimate loads for the screening analysis. A primary reason is that the EPACT-covered equipment (EPACT, P.L. 102-486) is used in a broad class of buildings (e.g., offices, warehouses, public assembly) rather than in any particular building type. Thus, specifying a highly detailed building geometry (size and shape) to represent one of these classes is unrealistic. However, for this analysis, it was necessary to establish the major characteristics that distinguish one building class from others (e.g., internal load levels, window-to-wall ratio).

Second, properly characterizing large classes of buildings requires eliminating any orientation biases because the actual building stock is oriented more or less randomly. Some analysts have approached this problem by simulating a square prototype with equal glazing area facing each cardinal direction. However, most real buildings are not square and loads based on a square prototype will improperly weight the influences of internal gains and external weather on building loads. Another approach is to simulate a building with a realistic aspect ratio in each of several orientations. This approach, of course, greatly increases the effort to obtain the load estimates.

Finally, the process of simulating a generic building and transforming the loads to represent a more realistic building not only addresses the previous two issues but minimizes the effort required to obtain load estimates for multiple representative buildings. A single BLAST simulation of a generic building can provide load estimates for many buildings of the same class.

A 3-story, 5 zones-per-floor generic building captures all the important zone types of the relevant building class. The 3-story prototype has a ground level, a roof level, and an intermediate level. Buildings with more than three stories can be represented by multiplying the middle-floor loads of the generic prototype. Further, each floor is represented by a core zone (i.e., a zone that has no exterior walls or windows) and a perimeter zone facing each of the cardinal directions. Buildings with more wall area facing one direction than others (i.e., buildings with nonsquare aspect ratios) can be represented by scaling or weighting the generic building zone loads to emphasize the dominant orientation(s).

A final benefit of this approach is that nonsquare buildings can be represented with a proper balance of internal load and external (weather) drivers without arbitrarily biasing the results toward a particular solar orientation. Because the building stock is more or less randomly oriented, to eliminate any bias from the solar gains, zone load from all perimeters must be equally weighted while perimeter versus core influence is adjusted to match the desired aspect ratio.

To get a realistic estimate of the coil loads for each of the seven representative building types selected for the analysis, the estimated coil loads from the generic building are scaled to represent an “average” or “typical” building size and shape. The scaling is accomplished by using the scaling algorithm developed for the Phase-I analysis (Barwig et al. 1996). The scaling algorithm takes the generic building loads and scales the loads to represent a building that is of a different size and shape given 1) total conditioned area, 2) number of floors, 3) number of zones per floor, 4) aspect ratio, and 5) perimeter depth.

The area, number of floors, and aspect ratio for the seven representative building types were estimated from the CBECS data (EIA 1992, 1995) weighted with the EPACT-covered equipment, while the number of zones per floor were assumed (see Table A.23). The perimeter depth for Assembly, Education, Lodging, and Office building types was assumed to be 15 ft, while the perimeter depth for the Food Services, Retail, and Warehouse building types were estimated from the floor area and the aspect ratio.

A.11 Service Water Heater Sizing

A.11.1 Sizing Curves

For this analysis, the ASHRAE *Handbook of HVAC Applications* equipment sizing curves were normalized (ASHRAE 1995). The normalized curves express storage capacity in terms of storage time (defined as the ratio of usable storage capacity to recovery capacity). With the normalized curves, presented in Figures A.1 and A.2, the ratio of a given water heater’s peak-load capacity to steady-state capacity in a given application can be obtained directly after computing the water heater’s storage time:

Table A.23. Building Size and Shape Characteristics for the Seven Representative Building Types for the Preliminary Analysis

Building Type	Number of Zones per Floor	Number of Floors		Aspect Ratio		Total Area (ft^2)	Perimeter Depth (ft)
		CBECS 95[(a)]	Suggested[(b)]	CBECS 92[(c)]	Suggested[(b)]		
Assembly	5	1.65	2	1.93	2	10,751	15
Education	5	1.61	2	2.56	3	25,594	15
Food Service	4	1.37	1	1.96	2	5,000[(d)]	25
Lodging	5	2.45	3	2.84	3	25,625	15
Office[(e)]	5	1.80	2	2.1	2	11,700	15
Retail[(f)]	4	1.49	1	2.14	2	13,448[(b)]	41
Warehouse	4	1.23	1	2.64	3	22,188[(b)]	43

(a) Actual number from EIA (1995).
(b) Suggested number for the screening analysis.
(c) Actual number from EIA (1992, 1995) did not collect this information.
(d) The area from CBECS was slightly adjusted to yield a nonfractional perimeter depth.
(e) Includes buildings that are classified as Healthcare (outpatient).
(f) Retail buildings including strip malls and enclosed shopping center/malls.

$$\text{Storage Time (hours)} = \frac{\text{Storage Volume (gal)}}{\text{Recovery Capacity (gph)}} \tag{A.2}$$

The analysis was further simplified by finding the slope and intercept for each sizing curve in the small region (Storage Time <1 hour) characteristic of EPACT-covered water-heating equipment. The fitted lines are plotted in Figure A.2 and the slopes and intercepts of these lines are reported in Table 2.4 of this report.

Building Types

The ASHRAE service water-heating chapter does not provide sizing curves for retail, warehouse, or assembly building types (ASHRAE 1995). Accepted numbers for occupant density and schedules in these building types were reported in previous work (Barwig et al. 1996). The time-distribution of weekday occupancy reported for retail, warehouse, and assembly building types is similar to that reported for the office building type. The office building type also has similar hot water uses (employees' and visitors' bathrooms), to the retail, warehouse, and assembly building types. For this analysis, therefore, the hot water use *per occupant hour* in the office building type was assumed to apply to these less-common building types.

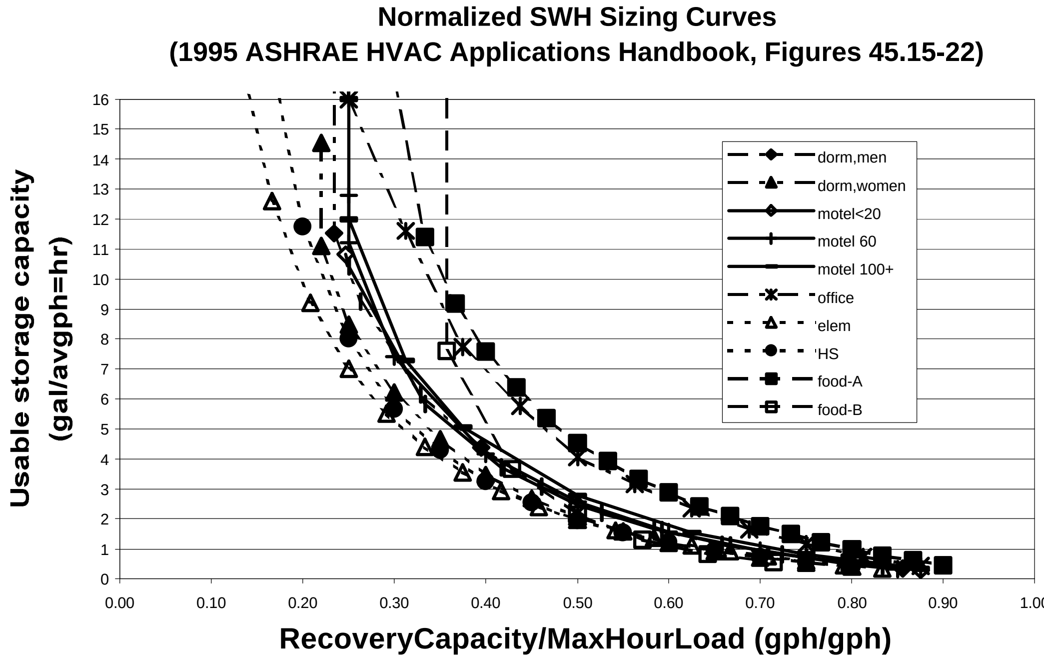

Figure A.1. Normalized Water-Heating Storage-Recovery Capacity Curves

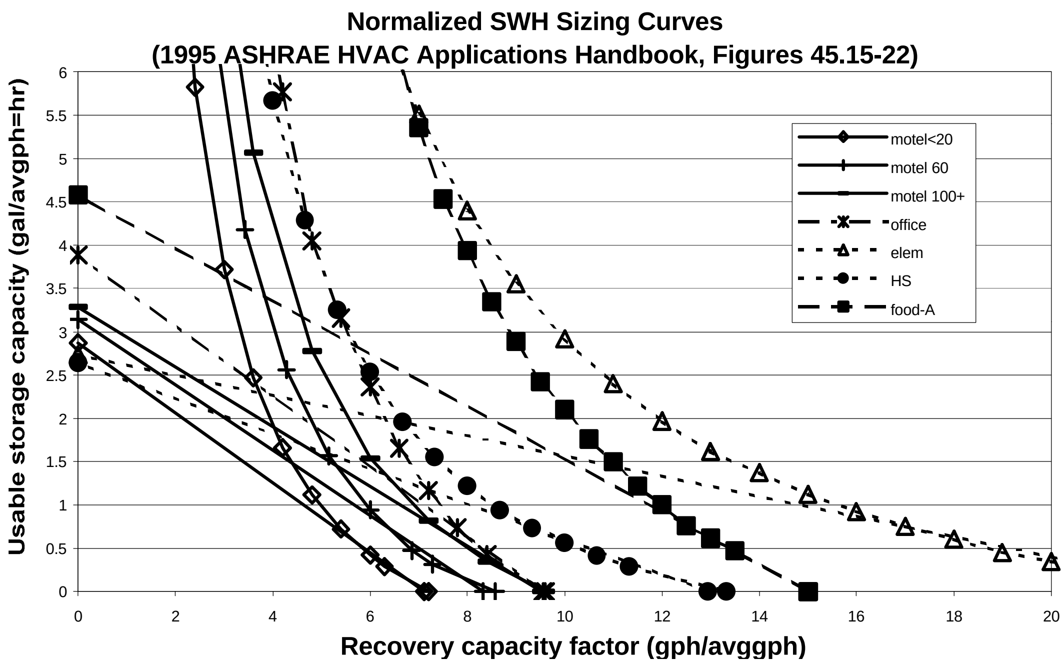

Figure A.2. Interpolation Lines for Storage Time <1 Hour

A.11.2 Service Unit Areal Densities

The sizing curves are expressed in terms of various service units; e.g., load per student, per occupant, per guestroom, and per peak-hour meal.[(a)] Occupant densities and schedules for the seven building types were developed for earlier standards development work (Barwig et al. 1996). The relationships between ASHRAE service units and floor area for this analysis are based primarily on the earlier work.

It is important to thoroughly document the occupancy assumptions because the term "occupancy" has different meanings in different contexts. Occupant densities and equivalent occupancy hours by day type are presented in Barwig et al. (1996, Table A.12), which are identical to the occupancy densities and occupancy schedules used in the screening analysis. In this scheme, "occupancy" means the *nominal occupant density* (people per ft^2), which corresponds to hours when the Table A.12 occupancy-factor = 1.00. The average hot water loads given in ASHRAE (1995, Table 45.7) are for days or weeks of normal building operation. One condition of normal building operation is that the daily or weekly time-integral of occupancy-factor corresponds approximately to the Table A.12 integral for the building type in question. Most buildings will experience many hours per year when occupancy exceeds the nominal value. A building's *maximum hourly* hot water load (defined in Table 2.6.2 [and in ASHRAE 1995, Table 45.7]) may correspond to an occupant density significantly larger than the nominal occupant density given in Barwig et al. (1996, Table A.12).

A brief description of the Table 45.7 data and rationale for its application to each building type follows.

Office. The ASHRAE guidance on hot water design loads (ASHRAE 1995, Table 45.7) uses *occupants* as the service unit for office buildings. The nominal occupant density for offices is 0.0033 people per ft^2 (Barwig et al. 1996).

Retail. Hot water uses include employee bathrooms, and break rooms and cleaning use. These uses are very similar to office hot water uses. The corresponding hot water volume demands and demand distribution are assumed to be similar, on a per-occupant basis, to the office. The occupancy profiles of retail buildings are also very similar to those of offices (Barwig et al. 1996). We therefore consider the retail service unit to be the occupant, and use a nominal occupant density of 0.0022 people per ft^2 (Barwig et al. 1996).

Warehouse. Hot water uses include employee washroom/breakroom and cleaning use. These uses are very similar to office hot water uses. The corresponding hot water volume demands and demand distribution are assumed to be similar, on a per-occupant basis, to the office. The occupancy profiles of warehouses are also very similar to those of offices (Barwig et al. 1996). We therefore consider the warehouse service unit to be the occupant and use a nominal occupant density of 0.0003 people per ft^2 (Barwig et al. 1996).

(a) We assume that meals per hour capacity is equal to the product of seating capacity and table turnover rate.

Education. The ASHRAE water-heating design guidance (ASHRAE 1995, Table 45.7) uses *students* as the service unit for schools. Two curves are given: one for elementary schools and the other for junior and senior high schools. ASHRAE recommends, however, that the elementary school curve be used for junior high schools and middle schools in which there is little or no shower use.

The U.S. student population is roughly distributed at 45% elementary, 10% middle school, 10% junior high, 20% high school, and 15% post-secondary school. Post-secondary can initially be ignored because it represents the smallest share of hot water use and, probably, the largest use of central plant heating with derivative service water heating. While the daily and hourly demands for high schools are about twice those for elementary schools, the normalized curves for elementary and high schools are almost identical. An average daily load of 1.3 gal per student and an average peak load of 0.8 gph per student can therefore be used with the average normalized sizing curve. A nominal areal density of 0.0107 people per ft^2 (Barwig et al. 1996) is assumed. This building type could be readily split into two, or possibly three, categories for future analysis.

Assembly. Hot water uses include employee bathrooms, and breakrooms and cleaning use, which are very similar to office hot water uses. The corresponding hot water volume demands and demand distribution are assumed to be similar, on a per-occupant basis, to the office numbers. The occupancy profiles of the assembly building type are also very similar to those of offices (Barwig et al. 1996). We therefore consider the assembly service unit to be the occupant, and have used a nominal occupant density of 0.016 people per ft^2.

Lodging. Normalized curves for the 20-room-or-less and 100-room-or-more motels are very close to the median (60-room motel) normalized curve shown in Figures A.1 and A.2. We have used the median sizing curve (60 units) to represent all lodging. The ASHRAE service unit for lodging is the guestroom. We have estimates of 300 ft^2 per guestroom from Taylor and Pratt (1989, 1990); Taylor (1992); EIA (1992); and Barwig et al. (1990). Service unit density of 0.0033 guestrooms per ft^2 was assumed.

Restaurant. The "Type A" (sit-down) restaurant represents most of the existing floor area and hot water use. We have used the "Type A" sizing curve and the corresponding design and average loads (ASHRAE 1995, Table 45.7) of 1.5 and 2.4 gal per meal. Note that the ASHRAE service unit is the *meal* because the number of meals served is a better predictor of hot water use than the number of occupants because patron residence times are so variable. Because available data are in terms of occupancy, we will consider occupant density to be the sum of staff and patron densities and assume that a given restaurant's *patron throughput* and *meal throughput* are equal.

Nominal occupant density is reported Barwig et al. (1996) to be 0.011 people per ft^2 (Tables A.12, A.14) and the equivalent (day-type-weighted) occupancy time per average day is 7.76 hours per day (Table A.12). Assuming a patron-hours to staff-hours ratio of 4:1 and an average patron throughput of 0.7 hours per meal, the *average* service unit areal density is 0.048 meals per day per ft^2. The average daily hot water load is calculated as 0.115 gpd per ft^2 (0.0048 gph per ft^2).

Peak meal throughput per unit area varies widely and a designer generally relies on the restaurant operator for an estimate. In the absence of national data, we can only make ad hoc estimates. If patron throughput and patron-to-staff ratio are both somewhat higher—say 2.0 meals per hour and 6 guests per staff during peak hot water load hours, the peak hour service unit areal density is 0.019 meals per hour per ft^2. The resulting peak hourly load is 0.0283 gph per ft^2.

Temperature Rise Affects Sizing

The recovery and storage capacities realized in a given *application*, rcva and stgtime, are related to the *rated* recovery capacity, rcvr(m) in gph, and *actual* storage volume, stgvol(m) in gallons, by:

$$rcva = rcvr(m)\ (T_{rtg,set} - T_{rtg,main}) / (T_{set}(b) - T_{main}(r)) \qquad (A.3)$$

and

$$stgtime = f_{use} stgvol(m)/rcva \qquad (A.4)$$

where $T_{rtg,set}$ = 90°F is the temperature rise used for rating water heaters
$T_{set}(b)$ = temperature set point in actual use
$T_{main}(r)$ = inlet temperature for region r
f_{use} = the usable storage capacity factor; f_{use} = 0.7 is a typical value.

The set point is taken to be a function of building type only with values of 140°F-160°F for restaurants, 120°F-140°F for warehouses and lodging, and 120°F for all others (Barwig et al. 1996; ASHRAE 1995). The inlet temperature is taken to be a function of region only, as enumerated in Table A.24.

Table A.24. Average Air and Water Inlet Temperatures

City (selected to represent region)	Surrogate City (simple mean of temperatures)	Normal Year Air Temperature (°F)	Assumed Water Inlet Temperature (air plus 2°F)
Providence	New York and Boston	52.8	54.8
Detroit	Chicago	49.0	51.0
Minneapolis		44.9	46.9
Knoxville	Nashville	59.1	61.1
Shreveport	Lake Charles	67.8	69.8
Orlando	Miami and Jacksonville	71.9	73.9
Denver		50.3	52.3
Phoenix		72.6	74.6
Seattle		52.0	54.0
Fresno		63.3	65.3
Los Angeles		63.0	65.0

A.11.3 Water-Heating Energy and Efficiency by Region, Building, and Equipment Type

The FLEOH calculation for service water-heating equipment differs from that for space-conditioning equipment because sizing is affected by storage, as well as recovery capacity. Another important difference is the need to convert loads from gallons to Btus and to convert the load bases from service units to square feet. It is also necessary to compute water heater standby loss based on the hours when the unit is not firing (assumed to be 8760-FLEOH). The water heater energy calculation steps are documented below. Note that units are assumed to be sized exactly by the ASHRAE procedures with no additional safety factor or allowance for the fact that equipment is only available in discrete sizes.

Installed Capacity. The continuous recovery capacity (in gallons) in a particular installation differs from the rated capacity by the ratio of the rating temperature rise (90°F) to the average actual temperature rise. The latter is the difference between set point temperature (Tset), assumed to be a function of building type as listed in Section 2.6.2, Table 2.X, and the mean annual inlet water temperature (Tinlet), assumed to be a function of region as listed in Table A.26. Installation-specific continuous recovery capacity is therefore given by:

$$\text{Recovery Capacity} = \text{Rated Recovery Capacity}\,\frac{90\,°\text{F}}{\text{Tset - Tinlet}} \qquad \text{(A.5)}$$

Storage Time. Storage time is defined in terms of the useable storage volume, assumed to be 70% of the rated volume, divided by the installation-specific continuous recovery capacity:

$$\text{Storage Time (hours)} = 0.70 \text{ x } \frac{\text{Storage Volume (gal)}}{\text{Recovery Capacity (gph)}} \qquad \text{(A.6)}$$

Storage Capacity Factor. A measure of a building type's peak hot water demand character, essential to both the sizing calculation and the FLEOH calculation, must be obtained from the ASHRAE curve for the building type of interest. Because the EPACT-covered water heaters all have storage times <1 hour and the curves are nearly linear in this region, we use a slope and intercept for each building type, as reported in Section 2.6.2, Table 2.4, and evaluate the storage capacity factor using the following expression:

$$\text{Storage Capacity Factor} = \frac{\text{Intercept - Storage Time/Slope}}{\text{Intercept}} \qquad \text{(A.7)}$$

Equipment Density. The floor area served by a water heater depends on its recovery capacity and its storage capacity factor *for the building type in which it will be installed*, as well as on the service unit density. This results in:

$$\text{Equipment Density (1/sf)} = \text{SUdensity(SU/sf)}\,\frac{\text{Average Daily Load (gpd/SU)} * \text{Storage Capacity Factor}}{\text{24(h/day)} * \text{Recovery Capacity (gph)}} \qquad \text{(A.8)}$$

FLEOH. A FLEOH (representing the number of hours of operation needed to serve the water heater load) is calculated for each water heater type in each building and location defined for the analysis. This calculation is necessary because water heaters are sized based on maximum load, and each building type has a different ratio of maximum-to-average load. This value is water heater-specific because storage allows the use of smaller continuous heating capacity to service a given peak load; increasing storage therefore increases FLEOHs. Note all analysis presented assumes that

$$\text{FLEOH} = \frac{\text{Average Daily Load} * \text{Days Per Year}}{\text{Maximum Hourly Load}} \text{Storage Capacity Factor} \tag{A.9}$$

This FLEOH is used to generate the annual energy use of the water heater to service the water heater load for each combination of water heater design, building type, and location. The additional energy use due to standby loss is calculated in the aggregation step based on the estimated hourly standby energy use for each design and the hours of standby, calculated as 8760 – FLEOH.

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Appendix B

B Aggregation Methodology Used to Estimate National Results

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The engineering simulations described Section 2 are conducted for particular building prototypes in locations chosen to represent distinct climatic regions of the U.S. To extrapolate the results of these simulations to a national level, a method is required to estimate the relative importance of each building in each location. This appendix describes the methodology and data sources by which the aggregation of various results to a national level is achieved.

Specifically, the building level FLEOH from the BLAST simulations are generated for each of 11 geographic locations (cities) and 7 building types. The first step in the aggregation methodology is to map these specific cities to a regional basis; the regions are generally defined in terms of census divisions. Census divisions are used because a variety of statistical data pertaining to human and building populations are available at that level. The combination of census divisions and building types yield distinct market segments for which estimates of their relative importance can be estimated from the available demographic information.

B.1 Disaggregation of Mountain and Pacific Census Divisions

One of the features of the screening analysis, as discussed in Section 3, is the generation of a distribution of life-cycle cost savings across various market segments—as just defined, in terms of building types and regions. A credible effort to estimate the distribution of economic benefits requires representing the major regional differences in both climate factors and energy prices. The census definitions of the Mountain and Pacific divisions suffer in this respect because they include very wide disparities of climate and electricity prices. Generally, the warmer areas within these regions – California and the desert Southwest – have much higher electricity prices than the northern areas. Thus, the use of only the official nine census divisions will blur the relative economic benefits to these areas resulting from the adoption of equipment efficiency standards.

The prior choice of climate locations in a previous analysis of several commercial products (Barwig et al. 1996) and the development of associated population weights suggested a natural disaggregation of the two western census divisions. The most natural division occurs in the Pacific census division, where a state level disaggregation separates Oregon and Washington from California. In the Mountain division, the break is represented by separation into a “North” region, represented climatically by Denver, and a “South” region represented by Phoenix.[a]

(a) The population weights from the previous analysis (Barwig et al. 1996) indicated a relative weighting of 0.64 for the Mountain-North and 0.36 for the Mountain-South.

This special disaggregation results in 11 geographic divisions. For the remainder of this section (and throughout much of the report), however, we will continue to refer to these divisions as census divisions. While this step adds some complexity to the analysis and requires gathering some additional information on building population characteristics, the separate identification of the northwest (represented by Seattle) and the desert southwest (represented by Phoenix) can, for some products, provide convenient bounding cases for the life-cycle cost analyses, as discussed in Section 3.

B.2 Translation of Climate Location Results to Census Divisions

The first step in the overall aggregation process is to translate the building level FLEOH from climate locations to the (modified) census divisions. Demographic information on existing[a] building square footage is available by census division. Therefore, the climate location results must be translated to a census division basis to incorporate demographic data for the various building types in the analysis.

This step essentially answers the question: How should the relative influence of the climate locations be estimated to construct an appropriately weighted measure for each census division? For example, three climate locations—Knoxville, Shreveport, and Tampa—were selected to generally represent the South (census *region).* What is the relative influence of each of these cities in describing each of the three census divisions—South Atlantic, East South Central, and West South Central—in the south?

In more specific terms, what is the relative representation (e.g., floor area) of commercial buildings for each of the climate locations (or portions of) that fall within the boundaries of a census division? In answering this question, estimates of the relative representation of commercial buildings were calculated from human population data from the USDA Economic Research Services (USDA 1993).[b] All metropolitan areas within the census division boundaries with a population of over one million were assumed to have significance in the calculation. The geographic distribution of these metro-populations is known by their corresponding central or fringe county populations.

After the modification of the census divisions as described in Section B.1, a weighting matrix is created that maps the 11 climate location results to the 11 (modified) census divisions. This matrix is shown in Table B.1. For example, FLEOH in the West North Central census division is determined by a weighted aggregation of the results from the Detroit and Minneapolis climate locations:

$$(\text{FLEOH})_{\text{WestNorthCentral}} = 0.6*(\text{FLEOH})_{\text{Detroit}} + 0.4*(\text{FLEOH})_{\text{Minneapolis}} \qquad \text{(B.1)}$$

(a) The units considered in this analysis can be replacements for existing units or new installations in new buildings. Commercial Building Energy Consumption Survey (CBECS) data representing existing construction was used to represent building demographic data (as opposed to ASHRAE, which used only new construction in its analysis) (EIA 1992, EIA 1995).

(b) Population data must be used in the first aggregation step as a surrogate for floor area because floor area, either total or by building type, is not known at the climate location level. This implies that the weighting procedure at this step is the same for all building types.

In more general terms, this transformation to a census division basis can be expressed as the dot product of a vector of climate location results with a vector of climate location weights (column 5 in Table B.1 West North Central division):

$$FLEOH_{WNC} = \sum_{m=1}^{11} X\_CL_m \bullet WCL_{m,4} \qquad \text{(B.2)}$$

where $FLEOH_{WNC}$ = aggregated FLEOH for the West North Central census division
X_CL_m = FLEOH for each of 11 climate locations
$WCL_{m,4}$ = 11 weights for the climate locations having influence in the West North Central census division (column 5 in Table B.1) (column 4 in Table CA).

The process described in Equation (B.2) above can be repeated for each of the seven building types considered in the analysis. The weighting matrix in Table B.1 is assumed to remain the same for all building types. This further generalization for the building types is shown in the equation below with the addition of a second index on the X terms.

$$FLEOH_{i,j} = \sum_{m=1}^{11} X\_CL_{i,m} \bullet WCL_{m,j} \qquad \text{(B.3)}$$

where $FLEOH_{i,j}$ = FLEOH for building type i and census division j
$X\_CL_{i,m}$ = FLEOH for building type i and climate location m
$WCL_{m,j}$ = influence or weight of climate location m within census division j.

As an illustration, the results of weighting the climate-location FLEOH pertaining to central cooling equipment are shown in Table B.2.

Table B.1. Aggregation Weights for Census Divisions

	New England	**Mid-Atlantic**	**East North Central**	**West North Central**	**South Atlantic**	**East South Central**	**West South Central**	**Mountain South**	**Mountain North**	**Pacific South**	**Pacific North**
Providence	1.000	1.000	0	0	0	0	0	0	0	0	0
Detroit	0	0	0.992	0.600	0	0	0	0	0	0	0
Minneapolis	0	0	0.007	0.400	0	0	0	0	0	0	0
Knoxville	0	0	0	0	0.507	0.675	0.134	0	0	0	0
Shreveport	0	0	0	0	0.177	0.326	0.806	0	0	0	0
Tampa	0	0	0	0	0.316	0	0.060	0	0	0	0
Denver	0	0	0	0	0	0	0	0	1.000	0.005	0.117
Phoenix	0	0	0	0	0	0	0	1.000	0	0	0
Seattle	0	0	0	0	0	0	0	0	0	0	0.884
Fresno	0	0	0	0	0	0	0	0	0	0.157	0
Los Angeles	0	0	0	0	0	0	0	0	0	0.838	0
Sum	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Table B.2. FLEOH by Census Division for Central Cooling Equipment

	Assembly	Education	Food Service	Lodging	Office	Retail	Ware-house
New England	1,059	766	1,523	842	1,059	1,281	880
Middle Atlantic	986	756	1,523	873	1,005	1,234	775
East North Central	955	664	1,368	779	961	1,179	775
West North Central	999	708	1,157	797	950	1,124	769
South Atlantic	2,235	1,510	2,820	2,192	2,017	2,321	1,738
East South Central	1,843	1,272	2,317	1,785	1,737	1,984	1,527
West South Central	2,209	1,488	2,858	2,138	1,995	2,288	1,676
Mountain North	1,164	819	1,749	974	1,295	1,385	1,207
Mountain South	2,823	1,990	3,487	2,781	2,559	2,841	2,534
Pacific North	794	562	1,361	503	1,018	1,246	881
Pacific South	1,626	1,154	2,616	1,126	1,844	2,266	1,205

B.3 Aggregation across Market Segments

As described in Section B.1, the 11 (modified) census divisions along with the 7 building types yields 77 partitions that we term "market segments." After translating the engineering results from a location (city) basis to market segments, the next step is to develop an estimate of the number of units of equipment shipped to (and assumed to be installed in) these segments. The approach separates the estimation of the distribution of shipments across these market segments from the projection of total national shipments. Total national shipments information is generally available for each product. The absolute numbers of shipments to the market segments are obtained by multiplying the estimated distribution by total national shipments.

B.3.1 Methodology

Shipments of any specified category of equipment consist of replacement units in existing buildings and units installed in new buildings (referred to below as simply "new" units). The relative shares of replacement versus new units depend primarily upon the lifetime of the equipment and the rate of growth of the building stock.

For both replacement and new units, the distribution methodology considers potentially three (multiplicative) factors:

1. Square Footage by Building Type and Region. Square footage data by building type and location is available from the Commercial Building Energy Consumption Survey (CBECS) (EIA 1992, 1995). Projections from EIA's Annual Energy Outlook (AEO) [generated by the National Energy Modeling System (NEMS)] provide a means of estimating the distribution of *future* building stock by region and building type (EIA 1999a).

2. Equipment Fractions of Floor Space. Equipment is not used in the same manner in all market segments. For example, boilers are primarily used in larger buildings; heat pumps are more prevalent in milder climates. The CBECS data can be used to estimate the percentage of floor space that is served by generic types of equipment for each market segment. These percentages can then be multiplied by the floor space estimates to develop the absolute amount of floor space served by the equipment.

3. Peak Load Intensities. The capacity of the equipment installed for a given amount of floor space will depend, to some degree, upon the peak load that it must serve. This variation is most prevalent in serving heating loads across the country. The peak-heating load that must be served in Minneapolis is significantly greater than it is in Tampa. These intensities are expressed in capacity (kBtu/h) per square foot (and can be estimated by the building energy simulations). When these intensities are multiplied by floor space served for a specific type of equipment, a measure of the total installed capacity is obtained for each market segment. The distribution of (existing or projected newly) installed capacity is then assumed to represent the distribution of replacement or new shipments across market segments.

For the screening analysis, the third factor--peak load intensities--was not used. For cooling, the results of the BLAST simulations suggested that the variation of cooling intensities did not vary greatly across regions. For heating equipment, the variation was more pronounced, but there remained the question of whether, for the same amount of floor space, more units of a given size were installed in colder regions, or whether the average equipment size was larger. Without some empirical information related to this question, we decided to omit this factor in the screening process.

The combining of the floor space and equipment shares matrices yields estimates of the distributions for both replacement and new equipment shipments. Thus, we have formally

$$\mathrm{MS[Replacment]}_{i,j} = \mathrm{FlSpcExist}_{i,j} \times \mathrm{EqShr}_{i,j} \text{ and} \tag{B.4}$$

$$\mathrm{MS[New]}_{i,j} = \mathrm{FlSpcNew}_{i,j} \times \mathrm{EqShr}_{i,j} \tag{B.5}$$

where $\mathrm{MS[Replacement]}_{i,j}$ = estimated share of national installed capacity in existing buildings by building type i and census division j

$\mathrm{MS[New]}_{i,j}$ = estimated share of national installed capacity in new buildings, by building type i and census division j

$\mathrm{FlrSpcExist}_{i,j}$ = floor space in existing building type i and census division j (normalized)

$\mathrm{FlrSpcNew}_{i,j}$ = floor space in existing building type and census division j (normalized)

$\mathrm{EqpShr}_{i,j}$ = share of floor space in building type i and census division j served by equipment in analysis

The principal difference between MS[Replacement] and MS[New] stems from the shift in regional construction—i.e., higher proportions of (projected) floor space in new buildings in the south and west as compared to the existing stock. In the future, this will tend to put slightly more emphasis on cooling equipment and less on heating equipment. Differences in the equipment fractions of floor space between existing and new buildings were assumed to be small for the screening analysis. Moreover, the CBECS does not contain sufficient numbers of observations to easily characterize equipment usage in new buildings.

Given estimates of the percentage of total national shipments that are replacement units, a final market shares matrix is computed as

$$MS_{i,j} = \text{(Replacement Shipments/Total Shipments)} \times MS[\text{Replacement}]_{i,j} + \text{(New Shipments/Total Shipments)} \times MS[\text{New}]_{i,j} \quad \text{(B.6)}$$

The methodology here does not try to develop detailed product-specific estimates of the shares of total shipments that are replacements versus those that are installed in new buildings. Some recent national studies of commercial equipment have used inventory models (using historical shipments data and assumed lifetimes) that could be exploited to split current national shipments into replacement and new equipment installations.[a]

For the screening effort, however, this information was not collected to make this split. Rather, some very simplifying assumptions were made to generate these shares. As a rough approximation, new buildings were assumed to make up about 1.5% of the building stock for any future years (1% net growth + 0.5% for removals). For cooling equipment, with an estimated life of 15 years, approximately 6.5% of the stock is replaced each year. Thus, the share of new units was assumed to be 1.5/(1.5+6.5) or about 20%. For boilers with a 30-year life we also assumed 20 to 80% split, based roughly on a view that boilers are not as prevalent in new buildings as they are in existing buildings. For water heaters, with a much shorter lifetime of 7 years, we assumed a 10 to 90% split. As will be shown below, the projected differences in the distribution of floor space between existing and new buildings is not so great as to make these assumptions significantly influence the final results.

B.3.2 Numerical Results for Specific Example

The results for large packaged air conditioning units are shown below to illustrate the aggregation methodology described above.

Floor Space Distributions

Table B.3 shows a projected distribution of floor space by region and building type for 2004. The distribution is normalized to sum to 1,000 ft^2 on a national basis. These values are taken from the commercial building module of the National Energy Modeling System (with the projection consistent with the AEO [EIA 1999a]). This projected distribution for 2004 is assumed to be a reasonable representation of where replacement equipment will be sold over the period 2004 to 2030.

(a) For example, Arthur D. Little, Inc. (ADL) conducted several studies in the 1990s for DOE that were based on this approach. One such study by ADL is R.F. Patel and A. Phylactopoulos. 1995. *Commercial Heating, Ventilation, and Air-conditioning Baseline Energy Use* (Draft).

Table B.3. Projected Distribution of Floor Space (per 1,000 total ft^2) for Period 2004

Region	Assembly	Education	Food Service	Lodging	Office	Retail	Ware-house	Total
New England	3.7	11.1	0.7	2.9	10.5	15.6	6.0	50.6
Middle-Atlantic	8.4	25.1	2.4	3.8	31.2	38.1	22.2	131.2
East N. Central	11.5	26.8	8.1	12.9	31.0	39.0	33.5	162.8
West N. Central	6.4	14.0	1.1	5.3	14.7	23.6	8.2	73.3
South Atlantic	13.3	21.0	3.7	15.2	44.3	45.2	33.8	176.4
East S. Central	5.6	7.9	2.2	7.1	12.9	27.3	22.5	85.5
West S. Central	8.4	21.6	3.4	5.4	23.2	29.3	17.8	109.0
Mountain North	6.0	8.0	0.9	6.1	13.0	6.7	7.7	48.4
Mountain South	3.4	4.5	0.5	3.5	7.3	3.8	4.3	27.2
Pacific North	1.7	3.5	0.8	2.3	7.3	5.1	3.8	24.4
Pacific South	7.9	15.8	3.5	10.5	33.2	23.1	17.3	111.2
Total	76.2	159.2	27.2	75.0	228.6	256.8	177.0	1000.0
Source: NEMS commercial model (for EIA 1999a), with adjustments for assembly and office buildings.								

Table B.4 shows a similar distribution for new construction. The distribution of new construction is represented by the floor space built in each market segment over the period 2010 to 2020, again taken from the NEMS commercial model. Note, for example, that the percentage of new construction in the Mountain North region is 7.1% (i.e., 71.1/1000), as compared to the 4.8% in existing (i.e., 2004) buildings.

Several adjustments were made to the projected floor space estimates generated by the NEMS model. First, the floor space for assembly buildings was adjusted downward; the screening analysis considered only public assembly buildings and omitted religious assembly buildings. Second, office floor space was increased to account for out-patient health care (the percentage increases varied by census division, based

Table B.4. Projected Distribution of Floor Space (per 1,000 total ft^2) for Period 2011-2020

Region	Assembly	Education	Food Service	Lodging	Office	Retail	Ware-house	Total
New England	3.2	9.6	0.3	3.3	6.3	13.3	3.7	39.8
Middle-Atlantic	4.9	22.0	0.9	2.8	16.2	32.3	13.8	92.9
East N. Central	8.0	30.4	6.8	10.5	19.4	38.5	28.2	141.7
West N. Central	5.8	17.1	1.3	3.7	10.0	20.4	2.6	60.9
South Atlantic	18.4	34.1	5.4	17.6	34.6	55.2	43.7	209.1
East S. Central	5.3	8.2	1.7	8.4	8.7	25.0	19.4	76.6
West S. Central	8.2	29.6	3.5	7.2	19.6	32.3	20.2	120.6
Mountain North	9.0	12.8	1.6	11.2	16.9	11.9	7.9	71.2
Mountain South	5.1	7.2	0.9	6.3	9.5	6.7	4.4	40.0
Pacific North	1.8	4.6	0.9	2.6	6.0	6.3	4.2	26.4
Pacific South	8.2	21.0	4.3	11.7	27.5	28.7	19.3	120.8
Total	77.9	196.4	27.6	85.3	174.7	270.5	167.5	1000.0
Source: NEMS commercial model (for EIA 1999a), with adjustments for assembly and office buildings								

upon the 1995 CBECS). Finally, the floor space for the Mountain and Pacific Census divisions needed to be split into the North and South components. Based upon the transformation matrices developed in Barwig et al. (1996), the Mountain North was assigned 64% of the floor space in Mountain census region, with the remainder going to the Mountain South. Pacific South is defined as California. It was assigned 82% of the floor space in the Pacific Census region. These shares were used for both existing and new floor space matrices.

The floor space distributions shown in Tables B.3 and B.4 are the same for all products covered by the screening analysis.

Equipment Shares

The 1995 CBECS data (EIA 1995) are used to estimate the percentage of floor space for each market segment served by each type of equipment. The CBECS collects information on packaged cooling equipment, boilers, furnaces, and water heaters. For each type of equipment, a matrix is constructed such that each element shows the fraction of the floor space served by that type of equipment in each region and building type. Lacking more detailed information, these generic matrices were used for all of the individual products within a product type. Thus, for example, the packaged cooling matrix was used for all of heat pump equipment as well as the air source and water source cooling equipment.

To ensure statistically valid results for the equipment shares, the data from the CBECS were aggregated to four broad regions. The regions were chosen to represent four quadrants of the U.S., as shown in Table B.5. The use of the quadrants was deemed to sufficiently represent the variations in equipment choice that may depend upon temperature differences between north and south regions, as well as differential humidity conditions between the east and the west.

Table B.6 shows the final equipment shares matrix for packaged cooling equipment. Stemming from the aggregation process above, the shares are repeated for each (modified) census division that is contained within a given quadrant.

Multiplying the floor space matrix for existing buildings (Table B.3) by the equipment shares matrix (Table B.6), and then normalizing the results to add to 100%, yields the distribution matrix for replacement sales. As described in Equation (B.5) above, the same process is followed to construct the distribution by market segment for units installed in new buildings. Here the floor space matrix for new construction (Table B.4) is multiplied by the same equipment shares matrix (Table B.6). The resulting distribution matrices are shown as Table B.7 and Table B.8.

Table B.5. Aggregation of Regions to Quadrants

Quadrant	Census Division
Northeast	Northeast, Middle-Atlantic
Southeast	South Atlantic, East South Central, West South Central
Northwest	Mountain North, Pacific-North
Southwest	Mountain South, Pacific-South

Table B.6. Equipment Shares for Packaged AC Equipment

Region	Assembly	Education	Food Service	Lodging	Office	Retail	Warehouse
New England	0.36	0.35	0.53	0.37	0.53	0.48	0.44
Middle-Atlantic	0.36	0.35	0.53	0.37	0.53	0.48	0.44
East N. Central	0.36	0.35	0.53	0.37	0.53	0.48	0.44
West N. Central	0.36	0.35	0.53	0.37	0.53	0.48	0.44
South Atlantic	0.40	0.49	0.70	0.43	0.54	0.56	0.34
East S. Central	0.40	0.49	0.70	0.43	0.54	0.56	0.34
West S. Central	0.40	0.49	0.70	0.43	0.54	0.56	0.34
Mountain North	0.31	0.13	0.71	0.23	0.62	0.57	0.15
Mountain South	0.62	0.42	0.58	0.32	0.57	0.64	0.60
Pacific North	0.31	0.13	0.71	0.23	0.62	0.57	0.15
Pacific South	0.62	0.42	0.58	0.32	0.57	0.64	0.60
Source: CBECS 1995							

Table B.7. Estimated Percentage of Distribution of Replacement Shipments for Large AC Equipment

Region	Assembly	Education	Food Service	Lodging	Office	Retail	Ware-house	Total
New England	0.3	0.8	0.1	0.2	1.2	1.6	0.6	4.8
Middle-Atlantic	0.6	1.9	0.3	0.3	3.5	3.9	2.1	12.6
East N. Central	0.9	2.0	0.9	1.0	3.5	4.0	3.1	15.5
West N. Central	0.5	1.1	0.1	0.4	1.7	2.4	0.8	6.9
South Atlantic	1.1	2.2	0.5	1.4	5.1	5.4	2.4	18.2
East S. Central	0.5	0.8	0.3	0.7	1.5	3.3	1.6	8.7
West S. Central	0.7	2.2	0.5	0.5	2.7	3.5	1.3	11.4
Mountain North	0.4	0.2	0.1	0.3	1.7	0.8	0.2	3.8
Mountain South	0.4	0.4	0.1	0.2	0.9	0.5	0.5	3.1
Pacific North	0.1	0.1	0.1	0.1	1.0	0.6	0.1	2.1
Pacific South	1.0	1.4	0.4	0.7	4.0	3.1	2.2	12.9
Total	6.6	13.1	3.5	5.9	26.8	29.1	14.9	100.0
Source: Computed as product of floor space distribution for existing buildings and equipment shares matrix.								

Corresponding to Equation (B.6), a final distribution matrix is constructed, given the assumption about the percentage of national shipments that are replacement units as compared to new units. As discussed at the end of Section B.3.1, for cooling equipment, the assumption used in the screening analysis was to assign 80% of shipments to replacement applications and 20% of shipments to new (post-2003) buildings. Using these weights, the final distribution matrix is shown in Table B.9. Thus, Table B.9 is constructed by multiplying Table B.7 by 0.8 and Table B.8 by 0.2 and then adding the results.

Table B.8. Estimated Percentage of Distribution of Shipments to New Buildings for Large AC Equipment

Region	Assembly	Education	Food Service	Lodging	Office	Retail	Ware-house	Total
New England	0.3	0.7	0.0	0.3	0.7	1.4	0.3	3.7
Middle-Atlantic	0.4	1.7	0.1	0.2	1.9	3.3	1.3	8.8
East N. Central	0.6	2.3	0.8	0.8	2.2	4.0	2.6	13.4
West N. Central	0.4	1.3	0.1	0.3	1.2	2.1	0.2	5.7
South Atlantic	1.6	3.6	0.8	1.6	4.0	6.7	3.2	21.5
East S. Central	0.5	0.9	0.3	0.8	1.0	3.0	1.4	7.8
West S. Central	0.7	3.1	0.5	0.7	2.3	3.9	1.5	12.6
Mountain North	0.6	0.4	0.2	0.6	2.2	1.5	0.3	5.7
Mountain South	0.7	0.6	0.1	0.4	1.2	0.9	0.6	4.5
Pacific North	0.1	0.1	0.1	0.1	0.8	0.8	0.1	2.2
Pacific South	1.1	1.9	0.5	0.8	3.3	3.9	2.5	14.1
Total	6.9	16.5	3.7	6.6	20.8	31.4	14.0	100.0
Source: Computed as product of floor space distribution for new buildings and equipment shares matrix.								

Table B.9. Estimated Percentage of Distribution of All Shipments for Large AC Equipment

Region	Assembly	Education	Food Service	Lodging	Office	Retail	Ware-house	Total
New England	0.3	0.8	0.1	0.2	1.1	1.5	0.5	4.6
Middle-Atlantic	0.6	1.8	0.2	0.3	3.2	3.8	1.9	11.8
East N. Central	0.8	2.1	0.9	1.0	3.3	4.0	3.0	15.0
West N. Central	0.5	1.1	0.1	0.4	1.6	2.3	0.7	6.7
South Atlantic	1.2	2.4	0.6	1.4	4.9	5.7	2.6	18.8
East S. Central	0.5	0.8	0.3	0.7	1.4	3.2	1.6	8.5
West S. Central	0.7	2.4	0.5	0.5	2.6	3.6	1.3	11.7
Mountain North	0.4	0.3	0.2	0.4	1.8	1.0	0.2	4.2
Mountain South	0.5	0.5	0.1	0.3	0.9	0.6	0.6	3.4
Pacific North	0.1	0.1	0.1	0.1	0.9	0.6	0.1	2.2
Pacific South	1.1	1.5	0.5	0.7	3.9	3.3	2.3	13.2
Total	6.7	13.8	3.5	6.0	25.6	29.6	14.7	100.0
Source: Computed as the weighted average of distributions of shipments to replacement and new construction markets.								

B.3.3 Aggregation to a National Result

The final step in the aggregation process is to produce a single national result. The national result is an aggregation across the market segments using weights that reflect the estimated shipments of commercial equipment to each market segment.

Because energy consumption is proportional to the FLEOH in each market segment, the weighting can be applied first to the FLEOH or at the end of the process to the unit energy consumption in each market segment. From an engineering viewpoint, it is perhaps useful to gain some perspective as to what the average operating hours may be for a specific piece of equipment across the U.S. The equation below represents this aggregation process.

$$\mathrm{FLEOH}_{\mathrm{US}} = \sum_{i=1}^{7} \sum_{j=1}^{11} \mathrm{MS}_{i,j} \bullet \mathrm{FLEOH}_{i,j} \tag{B.7}$$

where $\mathrm{FLEOH}_{\mathrm{US}}$ = a single FLEOH that represents all building types and the entire United States
$\mathrm{MS}_{i,j}$ = estimated shipments to each market segment expressed as a fraction of the total shipments in the United States.

In terms of the example for large air conditioners, the process described in Equation (B.7) indicates multiplying the FLEOHs in Table B.2 by the percentages in Table B.9 and adding the results. In this case, the national average FLEOH for large AC equipment is estimated to be 1,537 hours.

B.4 Price Estimates for Subcensus Divisions

Splitting the Mountain and Pacific census divisions into “north” and “south” regions, as described above, requires estimates of energy prices for these subcensus divisions. Information from the EIA *State Energy Price and Expenditure Report* (EIA 1998) report for 1995 was used to construct adjustment factors to estimate electricity prices for these breakout regions. As a first step, for both the Mountain and Pacific census divisions, the 1995 state data were aggregated to construct quantity-weighted prices for three groupings of states: 1) north, 2) south, and 3) all. The north region of the Pacific census division consists of Washington and Oregon. The south region is defined as California. For the mountain census division, the price for the south region is represented by the weighted average price of Arizona and Nevada. The remaining states in the Mountain census division were used to construct a price for Mountain North.

For the Pacific region, the published price in the AEO 2000 (EIA 1999b) was nearly 9% lower than the average price constructed from the state-level data for 1995. The reduction in the overall price was largely assumed to be the result of electricity deregulation in California. As a way to roughly calibrate to the AEO results, the electricity price for California was reduced by 11% prior to the averaging process. For 2000, this method yields a calculated price of $22.93 per million Btu (7.8 cents per kWh) versus the AEO estimate of $22.79 for the Pacific census division. This adjustment reduces the relative difference between the Pacific North and Pacific South over the forecast horizon and is qualitatively consistent with trends that may result from further deregulation of electricity markets. (For the Mountain region, the difference between the calculated and published data was not large and no special adjustment was applied.)

The second step was to create an adjustment factor for each subcensus division. Thus, for example, the adjustment factor for Pacific North is

$$\frac{\mathrm{P(PacificNorth)}}{\mathrm{P(Pacific)}} = \mathrm{F(PacificNorth)} \quad \text{(B.8)}$$

where P (Pacific North) and P (Pacific) are based on the 1995 *State Energy Price and Expenditure Report* (EIA 1998).

The results of these calculations generated the following adjustment factors:

Mountain North	0.91
Mountain South	1.14
Pacific North	0.62
Pacific South	1.17

For the projection period, the AEO projections are multiplied by the appropriate adjustment factor to generate the projected energy price for each subcensus division. Thus, continuing with the above example, the price for the Pacific North is equal to F (Pacific North) times the AEO projected price for the Pacific census division.

In essence, this procedure holds the relative differences between the subregions and the census divisions constant over the forecast horizon. Although the AEO suggests some narrowing of the electricity price differentials across the nine census divisions by 2020, the screening analysis does not extend this phenomenon to the subcensus regions in the west.

Differentials among states with respect to natural gas are much smaller than they are for electricity. The screening analysis used the overall census division price for both the north and south subdivisions in the Mountain and Pacific divisions.

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Appendix C

C Screening Analysis Spreadsheet: User's Guide and Model Documentation

Appendix C

Screening Analysis Spreadsheet: User's Guide and Model Documentation

C.1 Introduction

The screening analysis spreadsheet has been developed to assist the Department of Energy in assessing the benefits of setting efficiency standards for commercial space conditioning and water heating equipment. The spreadsheet was designed to estimate the energy savings and economic impacts of alternative efficiency levels for approximately 40 commercial space conditioning and water heating products covered by the Energy Policy Act of 1992 (EPACT, P.L. 102-486). The purpose of the analysis was to provide guidance as to which products may provide significant energy savings and economic benefits for efficiency levels that exceed those recently the ASHRAE Standard 90.1-1999 building standard.

C.2 Key Objectives

The development of screening analysis spreadsheet has been influenced by the following objectives:

1. *Transparency*. The principal reason for developing a spreadsheet-based methodology was to provide a reasonable level of transparency for estimating the economic and energy savings from a range of equipment efficiency levels. While spreadsheets can become very complex, they provide the best means to disseminate to a wide audience of interested parties the exact assumptions and data that produce a given set of numerical results. In the past several years, DOE has developed spreadsheets as part of the technical documentation of several appliance standards rulemakings.

2. *Flexibility*. The screening analysis was aimed toward a comparative analysis of products covered by EPACT. This phase of work may be followed by a more detailed analysis of products for which DOE may consider increasing efficiency levels beyond Standard 90.1-1999. A desirable feature of the model is the ability to use the same basic structure for both the screening analysis and subsequent more detailed analyses. To ensure flexibility, the spreadsheet includes features that allow it to automatically calculate savings for groups of products as well as providing the means to make in-depth analyses of selected products.

3. *User Efficiency*. In an era of powerful personal computers, computational efficiency is no longer an issue for analyses of this nature. Even considering the market segmentation approach implemented in screening analysis methodology, the spreadsheet model is basically an elaborate accounting structure with many multiplication and addition instructions. Promotion of user efficiency, however, remains a

goal of software of this type. Generally, this simply means automating the most common tasks that users may wish to perform. Some automation is included in the spreadsheet as a way of improving user efficiency, while still maintaining transparency.

C.3 General Spreadsheet Structure and User's Guide

This section covers two major topic areas. The first portion provides a general overview of how the various worksheets in the spreadsheet relate to each other. This will provide some key information to help the user navigate through the various worksheets. The second topic area discusses how the user can change key model parameters and execute the model.

C.3.1 Overview of Data Flow through the Worksheets

Figure C.1 presents the general linkages and data flow through the 18 worksheets currently making up the spreadsheet model. The direction of data flow is designated with arrows joining the worksheets—in spreadsheet parlance the lines with arrows between worksheets imply that cells in one worksheet refer to cells in another worksheet. Dashed lines denote that data is transferred via Visual Basic (VB) instructions (i.e., "macros") that perform the Copy and Paste Values functions in Excel.

The top two rows show the primary data inputs and assumptions that are used to calculate energy savings and net present value (NPV). In addition to these inputs, the equipment prices for selected discrete efficiency levels are in worksheet **ProductData** (shown at the right of row 3).

The two most important worksheets in the screening analysis spreadsheet are **CurrentProduct** and **Calc_Savings**. CurrentProduct assembles all data inputs that are specific to a single product. This includes the equipment capacity, equipment prices and efficiency levels, and total shipments. This worksheet can also be used to modify the matrices that define the distribution of equipment sales by building type and geographic region.

Calc_Savings performs all of the calculations to derive energy savings and NPV for each efficiency level. In broad terms this worksheet consists of three major sections. The section at the extreme left contains the main inputs and outputs, organized in the form of the product summary table. A middle section derives the distribution matrices that are used to weight the unit energy consumption by region and building type. The section at the right contains a series of arrays, with years shown horizontally and panels of values for each building type and region arranged vertically. These arrays are used to calculate unit energy consumption and life-cycle cost (LCC) for each market segment.

The bottom series of worksheets in Figure C.1 represent the key outputs from the model. **ProdTable** shows the one-page product summary table in the general format that was planned at the beginning of the screening analysis effort, a format that lays out the major input values and resulting energy savings and LCC/NPV measures. Supplemental information is shown below the table—investment performance and other measures as calculated from national average energy prices and unit consumption. ProdTable is created by copying (values only) the product summary table at the left of worksheet CurrentProduct.

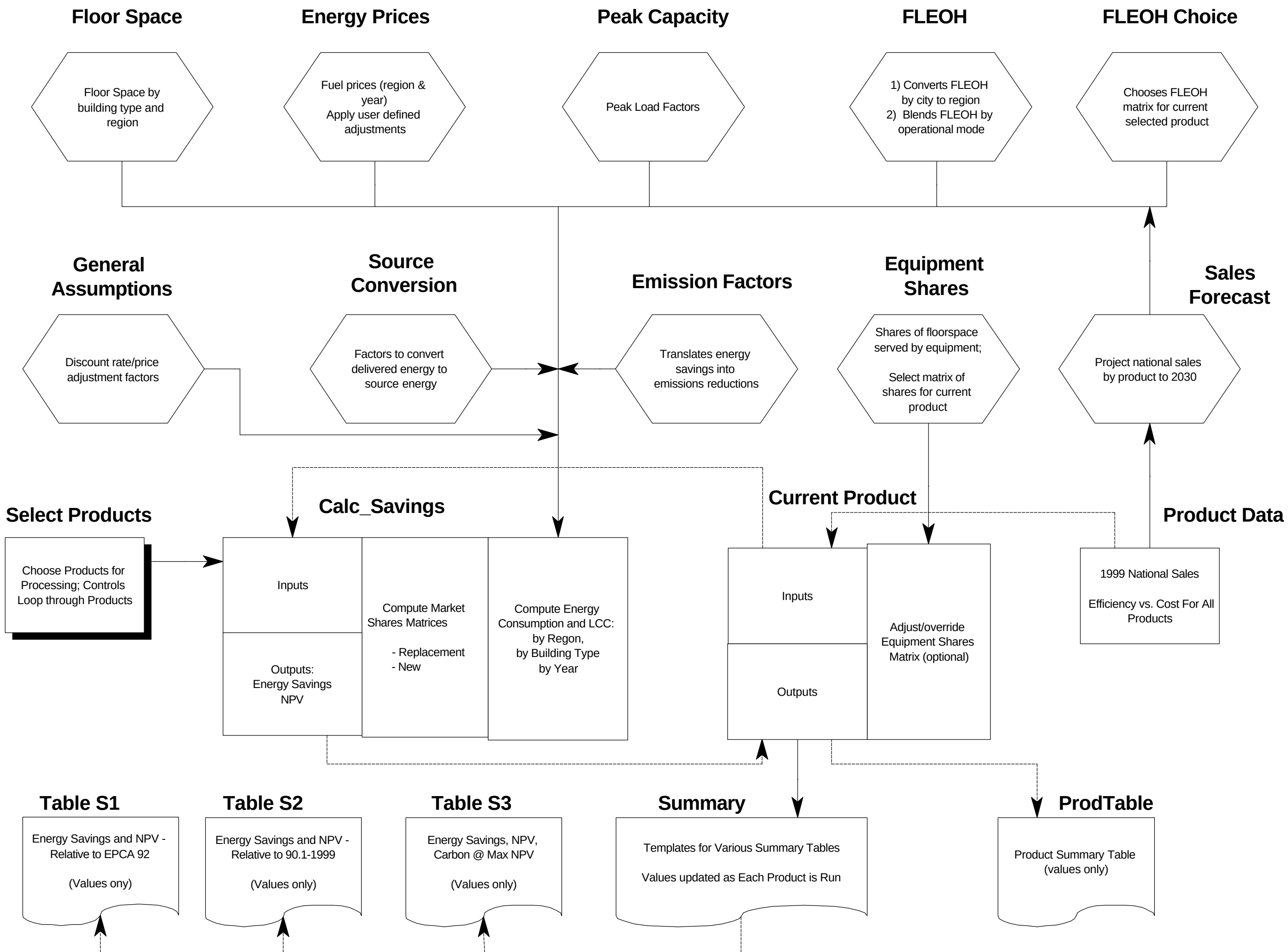

Figure C.1. Linkages and Data Flow Through the Worksheets in the Spreadsheet Model

Worksheet **Summary** collects key results that are placed in a single row in several summary tables corresponding to the single product. On the left side of the worksheet, templates are defined for six summary tables.

Table S.1 shows the energy savings and NPV for the Standard 90.1-1999 efficiency level, the efficiency level with highest NPV, and the highest efficiency level with positive NPV (all measured against the levels of equipment cost and efficiency in the Energy Policy and Conservation Act (EPCA, P.L. 94-163). In addition to these particular efficiency levels, Table S.1 shows the estimated number of products shipped in 1999.

Table S.2 shows the efficiency rating, energy savings, and NPV for the ASHRAE Standard 90.1-1999 level and for up to four higher efficiency levels. Equipment cost data were not defined for all four levels for some products. The table nevertheless provides a convenient way to look at the results for all products and all of the efficiency levels considered by the screening analysis. The savings metrics in this table are evaluated with respect to the Standard 90.1-1999 level.

Table S.3 shows the energy savings, NPV, and carbon emissions reductions for the efficiency level with the maximum NPV relative to EPCA 1992 and Standard 90.1-1999. As example of the type of output shown in the summary tables, Table C.1 shows the results for heating equipment from the spreadsheet's generic Table S.3.

Tables S.4 through S.6 provide the basis for several of the tables shown in Section 3. Table S.4 displays national energy savings for all efficiency levels. Table S.5 displays LCC for all efficiency levels. Table S.6 shows the energy savings and carbon emissions for Standard 90.1-1999 and the efficiency levels corresponding to maximum NPV.

Table S.1, **Table S.2**, and **Table S.3** are worksheets that are simply copies of the corresponding tables defined at the left side of the Summary worksheet. These worksheets consist of values only (no formulas) and can be conveniently copied to other spreadsheets for comparative analyses.

C.3.2 Changing Key Parameters and Executing the Spreadsheet Model

With reference to Figure C.1 and the information provided in the previous section, the key procedures that the majority of users would likely wish to employ with the spreadsheet can be described. This section shows how to change key macro parameters (e.g., discount rate or equipment price markups) or individual equipment price and efficiency assumptions.

The most important general assumptions are contained in the **Gen_Assumptions** worksheet. In this worksheet the user can change the discount rate, the markup from contractor cost to installed cost, and other parameters that can be used to adjust energy prices from the Annual Energy Outlook.

The spreadsheet model can be used to process an individual product or a series of products with a single click. As used in the screening analysis, the capability of the model to automatically process a series of products was used extensively. In this mode, the model introduces equipment price and

Table C.1. Heating Products Energy Savings and NPV for Efficiency Levels with Maximum NPV

Product	EPCA 1992		Standard 90.1 1999			Efficiency with Maximum NPV *Relative to 90.1-1999*				
	2004-2030 Baseline Consumption (TBtu)	**Thermal Efficiency (%)**	**Thermal Efficiency (%)**	**Energy Savings (TBtu)**	**Carbon Reduction (MMtons)**	**Thermal Efficiency (%)**	**Additional Energy Savings (TBtu)**	**Carbon Reduction (MMtons)**	**NPV (mill.98$)**	**IRR (%)**
Package Boilers, Gas Fired 400 kBtu/h, HW	684	75	75	0.0	0.0	78	26.3	0.3	$17.9	13.2%
Package Boilers, Gas Fired 800 kBtu/h, HW	1,493	75	75	0.0	0.0	78	57.4	0.8	$42.5	14.4%
Package Boilers, Gas Fired 1,500 kBtu/h, HW	491	75	75	0.0	0.0	88	72.6	0.9	$64.6	17.8%
Package Boilers, Gas Fired 3,000 kBtu/h, HW	324	75	75	0.0	0.0	88	47.8	0.6	$55.9	30.0%
Package Boilers, Gas Fired 400 kBtu/h, Steam	320	72	75	12.8	0.2	76	4.0	0.1	$1.6	9.4%
Package Boilers, Gas Fired 800 kBtu/h, Steam	875	72	75	35.0	0.5	76	11.1	0.1	$8.9	15.7%
Package Boilers, Gas Fired 1,500 kBtu/h, Steam	402	72	75	16.1	0.2	81	28.6	0.4	$10.5	9.0%
Package Boilers, Gas Fired 3,000 kBtu/h, Steam	256	72	72	0.0	0.0	82	31.2	0.4	$30.8	20.8%
Warm Air Furnaces, Gas Fired 250 kBtu/h	7,392	75.1	77.5	236.5	3.4	77.5	0.0	0.0	$0.0	NA
Warm Air Furnaces, Gas Fired 400 kBtu/h	7,562	75.1	77.5	241.9	3.5	77.5	0.0	0.0	$0.0	NA

efficiency data from the ProductData worksheet as each product is processed. In manual mode, the user can change price and efficiency assumptions or modify the matrices that define the distribution of product sales across market segments.

Automatic Mode. In this mode, the key worksheet is **SelectProducts**. To set up an analysis run, the user makes selections within the SelectProducts worksheet that will inform the model which equipment should be analyzed and what output is desired. After making the appropriate selections, the user clicks on the *Run Selected Products* button to initiate the analysis.

- Product Class Selection: At the top left portion of the worksheet, the user has a choice of selecting the class of products that will be analyzed. The choices are: 1) Space Cooling Equipment, 2) Space Heating Equipment, or 3) Water Heating Equipment. The user chooses one class of products by typing an "x" in the appropriate cell to the right of the product class of interest. This will tell the model which equipment to place in the Product Description list. If a product class is not selected, the default class is cooling equipment. Only one product class can be analyzed at a time.

- Product Selection: Below the selection of the product class, the user will select the specific products within the product class that will be processed by placing an "x" next to the product description in the Product Description list.

- Save Product Tables in an Output File Selection: To the right of the product class selection area is a switch that will allow the user to save the results of the run to an output file. Selecting this option allows the user to save the product summary table as each product is run and then the summary tables after all products have been processed. These saved tables are put into separate worksheets in a new Excel spreadsheet. This option must be used when analyzing more than one product from the product description list if the user wants to review the individual product tables. This is because the ProdTable worksheet containing the information specific to each product is overwritten by each consecutive product in the run. When the user elects to save the results to an output file, the user will be prompted for a file name. The output file is created and the product and summary tables are transferred to the output file automatically.

Manual Mode. In manual mode, the user runs only a single product at a time. Here the user starts in the CurrentProduct worksheet. In the top row of the worksheet, the user can type the product code for the product to be processed in cell C2. Product codes can be found in the SelectProducts worksheet. By clicking on the *Load Inputs* button to right of the product code, the user can load the default efficiency and equipment price information (as stored in the ProductData worksheet). Because the equipment price and efficiency data are copied via a Visual Basic procedure, the specific data values can be modified without disturbing the default information. Processing for each of the efficiency levels is initiated by clicking the *Calc Savings* button at the top left corner of the worksheet.

C.4 Results for Example Product

As mentioned above, the screening analysis spreadsheet model produces a summary page of results for each product. The top portion of this page is a high-level summary that presents LCC and energy savings, carbon reductions, and NPV for each efficiency level. The lower portion of the page shows supplementary information, with special emphasis on various measures of investment performance. This section explains the various input and output items included on the one-page summary and relates them to the methodology laid out in Sections 3 of the main report.

Figure C.2 shows the main results from the summary page for the high-capacity central air-conditioning equipment (≥135 kBtu/h and <240 kBtu/h). The top five items are straightforward. The equipment size is represented by output capacity—Btu/h that is transferred to the building space (or water in the case of water heaters). The estimated shipments for 1999 are shown for informational purposes only. The projected annual shipments between 2004 and 2030 drive the energy calculations. The cumulative total shipments are shown under the estimate for 1999.

C.4.1 Inputs by Efficiency Level

Most of the remainder of Figure C.2 is organized within seven columns, with each column representing a particular efficiency level. The first three columns are always linked to the same group of efficiency levels. Column 1 shows the EPCA 1992 efficiency and estimated equipment price. Column 2, labeled "Market Baseline," can be used to represent a higher average efficiency that may be more appropriate to the composition of shipments currently being installed. For the screening analysis, however, no formal attempt was made to collect such information. Accordingly, this value was set equal to the EPCA 1992 value for all products. The third column represents the efficiency level for Standard 90.1-1999.

The remaining columns show efficiency levels beyond Standard 90.1-1999 and vary by specific product. In only a few cases were sufficient data available to fill in all four efficiency levels beyond Standard 90.1-1999. Where appropriate, the labels on the top line give a rough indication of the source or rationale for the particular efficiency level.

The key inputs by efficiency are shown in the top two rows. The first row shows the efficiency rating (EER for AC/HP equipment, thermal efficiency (%) for heating and water-heating equipment). The next row shows the standby loss in Btu/h for water-heating equipment. The standby loss is zero for other equipment (boilers have a standby loss, but it is incorporated in the thermal efficiency measure for the screening analysis).

The next two rows show the equipment prices, first excluding and then including the markup from the manufacturer to the final consumer. The equipment price markup percentage is shown in the top left corner of the table.

Product: **Central, Air Source AC, >=135, <240**

Output Capacity (Btu/hr)	180,000	Estimated Shipments in 1999	65,000
Lifetime (years)	15	Projected Shipments, 2004-2030	2,086,082
Equip. Price Markup	25%		

Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	90.1R Tier 2	Tier 1 Analysis	Upgrade Group	MaxTech
EER	8.5	8.5	9.7	10.2	10.4	10.8	11.5
Standby Loss (NA)	0	0	0	0	0	0	0
Equip. Price (w/o markup)	$6,798	$6,798	$7,614	$7,886	$8,089		
Equip. Price (w/ markup)	$8,497	$8,497	$9,517	$9,857	$10,112	NA	NA
Year of Standard	NA	NA	2004	2004	2004	2004	2004
LIFE CYCLE COST (LCC) SAVINGS, for 2010				**1998 Dollars per Unit**			
Savings relative to EPCA 1992							
Weighted Average LCC Savings			$1,431	$1,942	$2,005	NA	NA
Max LCC Savings			$5,163	$6,970	$7,516	NA	NA
Min LCC Savings			-$491	-$648	-$834	NA	NA
Percentage of units with LCC savings > 0			97.5%	97.5%	95.4%	0.0%	0.0%
NATIONAL ENERGY SAVINGS				**Trillion Btu (Primary)**			
Relative to EPCA 1992							
2010			20.6	27.8	30.4	35.5	43.5
2020			44.6	60.0	65.8	76.7	94.0
2030			46.6	62.8	68.9	80.3	98.4
2004-2030			899.4	1,211.7	1,328.2	1,548.3	1,896.6
Relative to Standard 90.1-1999							
2010				7.2	9.8	14.9	22.8
2020				15.5	21.2	32.2	49.4
2030				16.2	22.2	33.7	51.7
2004-2030				312.3	428.8	648.9	997.2
EMISSIONS REDUCTIONS (2004-2030)				**Million Metric Tons**			
Relative to EPCA 1992							
Carbon Equivalent			13.2	17.8	19.5	22.8	27.9
NOx			0.12	0.16	0.18	0.20	0.25
Relative to Standard 90.1-1999							
Carbon Equivalent				4.6	6.3	9.5	14.7
NOx				0.04	0.06	0.09	0.13
NET PRESENT VALUE (NPV) @ Discount Rate of		7.0%		**Million 1998 Dollars**			
Relative to EPCA 1992			$1,042.2	$1,414.4	$1,460.1	NA	NA
Relative to Market Baseline				$372.2	$417.9	NA	NA
Adjust AEO Fuel Prices:	Multiplier:	1.05	Adder ($/kWh):		$0.000		
Report created:	3/13/00 8:25 AM						

Figure C.2. Product Summary Table (Main Results) for Large Central Air Conditioners

The final input row shows the year in which the standard is assumed to become effective. For the screening analysis, 2004 was chosen for all products and efficiency levels. The user of the spreadsheet model has the ability to modify the dates to reflect the additional time a full rulemaking or alternative approach might delay implementation of a new standard.

C.4.2 Outputs by Efficiency Level

The remainder of the table shows the results of the analysis organized by efficiency level. The top four rows pertain to LCC savings on a per unit basis [as derived from Equations (3.8) and (3.10)]. Based upon the estimated distribution of shipments to the 77 market segments, the top row shows the weighted average LCC savings based on the projected energy prices for 2010 and subsequent years [per Equation (3.10)]. All savings are calculated relative to the EPCA 1992 efficiency level. For the example product, the 135-240 kBtu/h cooling unit, the average LCC savings increases from $1,431 per unit to $2,005 per unit.

The next two lines indicate the maximum LCC saving and minimum LCC saving across the 77 market segments. The variation in regional energy prices and climate typically lead to LCC savings in some segments that differ significantly from the weighted average. The last line of this section provides a measure of how pervasive the LCC savings are for higher efficiency levels. The "percentage of units with LCC savings > 0" is based on the sum of the market shares for segments that show positive savings relative to EPCA 1992. Although this metric was not used in the formal screening analysis, similar distributional measures have been incorporated in prior DOE analyses for residential appliances. For the high-capacity cooling unit, an EER of 10.4 would still yield LCC savings for an estimated 95.4% of total shipments, based upon energy prices for 2010 and subsequent years.

The next panel of outputs shows the estimates of national energy savings. Energy savings are computed relative to both the EPCA 1992 efficiency level and the Standard 90.1-1999 efficiency level. The results are shown for three specific years: 2010, 2020, and 2030—as well as for a cumulative total from 2004 through 2030. The conversion to primary energy units is described in Section 3.2.

The emissions reductions shown in the next panel are related directly to the energy savings. As cited in Section 3.5, the factors to convert energy to emissions are taken from DOE's Office of Energy Efficiency and Renewable Energy (EERE) as part of the Government Performance and Reporting Act (GPRA) metrics program. As above, the emissions savings are shown relative to both EPCA 1992 and Standard 90.1-1999.

The last panel of outputs in this part of the table presents the estimates of national NPV. NPV is calculated as shown in Equation (3.13) in Section 3.2.4 and is calculated relative to both the EPCA 1992 and Standard 90.1-1999 baseline efficiency levels. As shown in the table, the NPV estimates were based upon a 7% real discount rate.

C.4.3 Supplemental Results

The supplemental results section of the product summary table, as shown in Figure C.3, is intended to provide more information to help evaluate and crosscheck the detailed results. The top panel of the supplemental results portion of the table relates to measures on a per unit basis.

The first two rows provide the two factors that yield unit energy consumption. The first row translates the output capacity and efficiency rating into the input capacity—expressed in kW or MMBtu/h. The second row shows the national average full-load equivalent operating hours ($FLEOH_{US}$). The product of these two factors provides an estimate of (national average) annual unit energy consumption.[a]

The next section of the table shows key economic variables on a per unit basis, again based upon the energy prices and other inputs for 2010. The national average energy price abutting the right margin of the table is taken from the *2000 Annual Energy Outlook* (AEO) (EIA 1999a), but includes any adjustments requested by the user. As discussed in Section 3.2.1, a 5% multiplier was applied to electricity prices for the screening analysis.

Life-Cycle Cost

Two sets (rows) of LCCs are displayed in the supplemental results. Both sets of LCC's are assumed to apply to units purchased in 2010 and include the effects of any energy price trends (from the AEO 2000 projection [EIA 1999a]) through the operating lifetime of the equipment. The first LCC ("LCC/wgted market segments") shows the national average LCC, weighted by the projected number of shipments to each market segment. Thus, it employs both FLEOH and energy price at the subcensus division in constructing the national average. The LCC's in the second set ("LCC/ave energy price") are assumed to apply to a single unit purchased in 2010 for which the national average energy price is paid. These two rows correspond to Equations (3.10) and (3.11), respectively, in the main portion of the report.

Measures of Investment Performance

The next section shows a series of measures of investment performance related to the increase in first cost and lower annual energy costs for each efficiency level. Again, these measures are calculated for the inputs for 2010 and thus include the small energy price trends in the AEO projections beyond that year. Two sets of measures are shown: 1) investment performance measured relative to the EPCA 1992 efficiency levels and related costs, and 2) investment performance relative to the Standard 90.1-1999 efficiency levels and related costs.

As discussed earlier, the NPV value shown in this section is equivalent to LCC savings on a unit basis. The NPV values in the supplemental results section of the table (relative to EPCA 1992) will not exactly match the unit LCC savings estimates shown at top of the table (in Figure C.2). The unit LCC savings at the top of the table are based upon weighting the LCC savings for individual market segments

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(a) For water heaters, the annual standby loss would need to be added to this result. See Equation (3.3).

Supplemental Results							
Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	90.1R Tier 2	ASHRAE Tier 1 Analysis	Upgrade Group	MaxAvail
Key Results: Per Unit Basis							
Input Capacity (kW)	21.176	21.176	18.557	17.647	17.308	16.667	15.652
National Ave FLEOH	1,537.1	1,537.1	1,537.1	1,537.1	1,537.1	1,537.1	1,537.1
Life-Cycle Costs: 1) wgted market segments , 2) w/nat. ave. energy price					2010 Ave. Energy Price=		$0.067
1) Wgted LCC	$28,308	$28,308	$26,877	$26,366	$26,303	NA	NA
2) LCC/ave energy price	27,942	27,942	26,556	26,061	26,004	NA	NA
Measures of Investment Performance For Efficiency Levels Exceeding EPCA 1992 (for Year 2010)							
Based on National Average Values for Unit Consumption and Energy Price--Relative to EPCA 1992							
Payback Period (yrs)			3.8	3.7	4.1	NA	NA
Cost of Saved Energy ($/kWh)			$0.028	$0.028	$0.030	NA	NA
NPV (= LCC Savings) ($)			$1,386	$1,881	$1,938	NA	NA
Internal Rate of Return			25.1%	25.4%	23.2%	NA	NA
Based on National Average Values for Unit Consumption and Energy Price--Relative to Standard 90.1-1999							
Payback Period (yrs)			NA	3.6	4.6	NA	NA
Cost of Saved Energy ($/kWh)			NA	$0.027	$0.034	NA	NA
NPV (= LCC Savings) ($)			$0	$495	$552	NA	NA
Internal Rate of Return			NA	26.3%	19.8%	NA	NA
Break-even cost multiplier				2.457	1.928	NA	NA
Aggregate Measures							
National Energy Consumption			**Trillion Btu (Primary)**				
2010	166.6	166.6	146.0	138.8	136.1	131.1	123.1
2020	360.3	360.3	315.7	300.2	294.4	283.5	266.3
2030	377.1	377.1	330.4	314.2	308.2	296.8	278.7
Cumulative, 2004-2030	7,270.2	7,270.2	6,370.8	6,058.5	5,942.0	5,722.0	5,373.7
Emissions			**Million Metric Tons**				
Carbon (MMtons)	111.5	111.5	98.3	93.7	92.0	88.7	83.6
NOX (MMtons)	1.0	1.0	0.9	0.8	0.8	0.8	0.8
Discounted LCC for Nation			Millions of 1998 $				
from Market Segments	27,547.8	27,547.8	26,505.6	26,133.4	26,087.7	NA	NA
National NPV							
Relative to EPCA 1992			1,042.2	1,414.4	1,460.1	NA	NA
Relative to 90.1-1999				372.2	417.9	NA	NA
Quick Calc with National Averages (2010)		***(Note: Energy price fixed at 2010 value)***					
Energy Price ($/kWh),	$0.067	$0.067	$0.067	$0.067	$0.067	$0.067	$0.067
Ann. energy use (kWh)	32,550	32,550	28,523	27,125	26,604	25,618	24,059
Standby Losses (kWh)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy cost, $/yr	$2,175	$2,175	$1,906	$1,813	$1,778	$1,712	$1,608
PV (energy cost)	$19,813	$19,813	$17,362	$16,511	$16,193	$15,594	$14,645
Equipment Cost	$8,497	$8,497	$9,517	$9,857	$10,112	NA	NA
Unit LCC	$28,311	$28,311	$26,879	$26,368	$26,305	NA	NA

Figure C.3. Product Summary Table (Supplemental Results) for Large Central AC

(as shown by Equation 3.10). In the supplemental results section, the NPV estimate is based upon a single unit evaluated with the national average energy price and with the national average FLEOH [as per Equation (3.11)].

As mentioned above, in addition to LCC and NPV, several other measures can be used to evaluate investments in increased energy efficiency of the equipment. The principal measures are 1) payback period, 2) cost of conserved energy, and 3) internal rate of return.

Payback Period

The simple payback period measures the amount of time required to recover the incremental equipment cost through lower operating costs. By using k to designate the efficiency level (where k = 0 represents the base cost), the equation for payback is

$$\text{Payback}(k) = \frac{\text{EqpCost}(k) - \text{EqpCost}(0)}{\text{OpCost}(k) - \text{OpCost}(0)} \tag{C.1}$$

Payback periods are expressed in years. Thus, a payback period of five years indicates that it takes five years of operating (energy cost) savings to equal the additional purchase cost of the equipment. The *simple* payback does not consider the foregone interest yield on the money used to pay the additional purchase cost. If the payback period is longer than the life of the product, the purchase price is never recovered in reduced operating expenses.

Cost of Conserved Energy

The cost of conserved energy (CCE) is the hypothetical price of energy that would make the LCC savings (or NPV) of the investment equal to zero. Based on Equation (3.7), CCE is calculated as the PFUEL that satisfies the equation:

$$\text{EQPCOST} + \sum_{t=1}^{N} \frac{\text{Rated Capacity x FLEOH x PFUEL}}{(1+r)^t \text{ x Rated Efficiency}_k} = 0 \tag{C.2}$$

Based on an LCC criterion, an investment is cost effective if the CCE is less than the purchase price of energy. Thus, for example, an investment for which the CCE for electricity is less than 2 cents per kWh would be cost effective in nearly all regions of the United States. CCE is most often used in utility planning to compare the marginal cost of energy associated with building new generation capacity with that of investing in energy conservation measures.

Internal Rate of Return

The internal rate of return (IRR) approach measures the percentage yield on an investment. It uses the same cost elements as the LCC method, but differs in two ways: 1) in its unit of measure, a percentage rather than dollars, and 2) in the way the discounting is performed. The IRR approach *solves* the value of the discount rate that will equate discounted total benefits (reductions in operating costs) to the cost of the investment. This rate can be compared against a discount rate that represents the consumer’s minimum acceptable rate of return. In the context here, the investment in increased efficiency is deemed cost effective if the IRR exceeds a prescribed discount rate.

The computation of the IRR is conceptually similar to the computation of the CCE. Again, beginning from Equation (3.7), the IRR is calculated as the discount rate r that satisfies the following equation:

$$\mathrm{EQPCOST} + \sum_{t=1}^{N} \frac{\text{Rated Capacity x FLEOH x PFUEL}_t}{(1+r)^t \text{ x Rated Efficiency}_k} = 0 \qquad \text{(C.3)}$$

While all these measures have been used in various analyses of efficiency standards and other energy conservation programs, they have particular strengths and weakness with respect to comparing diverse types of energy-using equipment. Payback is appropriate to comparing alternative efficiency levels for a single product, but it fails to account for different equipment lifetimes between products. The payback measure sometimes does not reflect the comparative benefits of higher efficiencies for longer-lived equipment (e.g., boilers). The cost of conserved energy must be normalized to satisfactorily compare equipment using different fuels. For simple investments in which all investment cost is incurred at the outset (as is the case with the installation of higher efficiency equipment), the IRR provides a neutral measure that can be used to compare the relative value of alternative investments.

Investment Performance for Example Product

For the large air-conditioning equipment shown in Figure C.3, the simple payback at the maximum NPV level (efficiency level 4)—relative to the Standard 90.1-1999 level—is 4.6 years. The cost of conserved energy (electricity) is 3.4 cents, just over half the 2010 national average price of 6.7 cents. The IRR is computed to be 19.8%.

National Results

The bottom of the supplemental results section shows the aggregate absolute values for energy consumption, emissions, and NPV. The various national energy and emissions savings measures are computed from these values

The energy consumption numbers need to be carefully interpreted. They are based only on sales of equipment from 2004 and later. As such, the energy consumption estimate for 2010 is not an estimate based upon the *total* stock of equipment in place in that year. For most cooling equipment and water heaters, with lifetimes less than or equal to 15 years, the 2020 number may provide a reasonable estimate of national energy consumption. By 2020, all existing equipment would have been replaced and the entire stock would reflect the efficiency level shown at the top of that column in the table. With assumed lives of 30 years for boilers, even the 2030 value would fall somewhat short of yielding an appropriate measure of consumption for the stock of this equipment. The lack of incomplete turnover, however, is not an issue for selecting optimal efficiency levels because the screening analysis is only concerned with the differences in consumption levels for products shipped in 2004 and later years.

The second to last two rows ("Total LCC for Nation") provide a further diagnostic for the LCC calculations. In the row labeled "from market segments," total (discounted) LCC is computed as first summing the total LCC (unit LCC times units shipped) over the 77 market segments and then discounting the total back to the year 2000.

The last two rows present the national NPV as calculated from two baselines—EPCA 1992 and Standard 90.1-1999. As described in Section 3.4.2, the national NPV is based upon the discounted LCC values aggregated from the market segments (as shown in the preceding line). Thus, for example, the NPV for efficiency level 4 relative to Standard 90.1-1999 is equal to $26,088 - $25,506 or $418 million.

Below the boxed area for the supplemental is a short section entitled "Quick Calc.". This section illustrates the energy and first cost components that go into estimates of LCC. The LCC estimates here use the national average FLEOH and a constant 2010 price of energy. The second and third rows in this section show the annual unit energy consumption for the hours in which the unit is operating and for the hours the unit is idle (i.e., standby loss). The sum of the these entries times the (2010) energy price in row one yields the annual cost of energy, as shown in the fourth row. The next row shows the present value (PV) of the energy cost, computed by discounting the energy costs over the expected lifetime of the equipment. The sum of the present value of the energy cost and the (first) cost of the equipment is the LCC, as shown in the final row of the table. The LCC estimates developed in this section will differ slightly from those described in the supplemental results section because they employ a constant (2010) price of energy.

C.5 Technical Documentation

This section provides more detailed documentation of the screening analysis spreadsheet that may be useful to those who wish to change some of the other data inputs that influence the energy savings and NPV estimates. It is also designed to facilitate future efforts to incorporate additional features in the spreadsheet.

C.5.1 Common Programming Methods

Current Data. Many of the data inputs vary by the key attributes of the product. For example, heating product FLEOH are different from cooling product FLEOH. Fuel prices vary by product as well as the vectors used to convert site-based energy consumption into source or primary energy.

Variable names are used throughout the model to select the appropriate data inputs. Key variables that control the selection of data inputs are:

product_code	abbreviated name for each product
product_class_code	cooling (1), heating (2), and water heating (3)
fuel_code	electricity (1), gas (2), fuel oil (3)

For most worksheets containing input data, the various data arrays are arranged vertically. For example, in the worksheet EnergyPrices, the arrays for electricity, natural gas, and fuel oil prices are arranged on top of each other, beginning at row 20. Depending upon the fuel code, the appropriate energy price data for the product being processed is moved to the top of the worksheet. This translation is accomplished using Excel's OFFSET function.

This same procedure is used in a number of worksheets. In general, the specific data that is related to the current product is moved to the top of the worksheet. In most cases, this area is labeled the “current” data set. This approach fixes the locations of cells from which the links between worksheets are built. It also makes it easy for the user to move between the various input worksheets and check the data being requested for a specific product.

Conditional Updating. Early in the development of the spreadsheet model, it became clear that storing all of the intermediate results for each efficiency level would yield an unmanageably large spreadsheet. Accordingly, the spreadsheet model extensively uses a programming method that might be termed “conditional updating.” Essentially, it means that the spreadsheet cells holding final results are updated only when certain conditions are met. To illustrate, the product summary table in worksheet Calc_Savings has a column associated with each efficiency level. Most of the cells in this part of the worksheet have a formula similar to the following example:

=If(eff_level=j, d89=a89, d89)

This formula is placed in cell d89. A final value, which has been calculated elsewhere in the spreadsheet, resides in cell a89. If the efficiency level is equal to “j”, then cell d89 is replaced by the value in cell a89. Otherwise the value is not changed—i.e., the value in cell d89 is set equal to itself. This method makes it possible to build up a table of results in a step-wise fashion. The spreadsheet model updates cells using conditional updating for both the results table in Calc_Savings and the summary results in the Summary worksheet.

By using the conditional updating method, Excel thinks the model is making circular references and will periodically issue a warning to that effect. This warning can be easily removed by setting the model to an iterative calculation mode and specifying 10 iterations for its solution. This step can be performed manually by going into the Tools\Options\Calculation menu. The spreadsheet is set to this mode automatically when one or more products from the SelectProducts worksheet are analyzed for the first time.

C.5.2 Worksheet Descriptions

This section describes each of the worksheets in the spreadsheet model, in the order in which they are organized in the spreadsheet. Special Excel functions are identified and briefly explained.

a) Gen_Assumptions

This worksheet contains common assumptions applicable to all products, including discount rate, equipment price markup, and fuel price adjustments.

b) SelectProducts

This worksheet provides a list of products for which default input data are defined. It permits the savings calculation to be made for multiple products at a time, with the option of savings the results to a separate file. The worksheet is described in greater detail in Section C.3.2.

c) Summary

This worksheet generates three summary tables that list energy savings and NPV for all defined products. Columns B through AR contain the results of the conditional updates and the selection of maximum NPV that is performed in columns AS through CT. The worksheet is described in greater detail in section C.3.1.

d) CurrentProduct

This worksheet defines the working area--accepting both input and output values--for a specific product. In automatic mode, the inputs required to generate energy savings and LCC/NPV are copied via Visual Basic code from worksheet ProductData. In manual mode, this same data can be copied by clicking the "Load Default Data" at the top of the worksheet. At this point, the user can edit any of the input values.

This worksheet also accepts inputs from EquipShares and Calc_Savings in columns N through X. The user can either modify or override the matrix that defines the distribution of shipments by market segment. The user can override the default inputs by placing a "Y" in cell AR48 and supplying distribution inputs for calculations in columns Z through AX. Distributions can be separately adjusted or chosen for replacement units in existing buildings or for new units.

After calculation of the energy savings and LCC/NPV results in worksheet Calc_Savings, the results are copied to the product summary table in this worksheet (via Visual Basic code). Thus, both the inputs and outputs for the product summary table are copied in from other parts of the spreadsheet. In automatic mode, the entire product summary table is copied to worksheet ProdTable before processing is started for the next product.

e) Calc_Savings

Calc_Savings contains the logic to calculate energy and LCC savings by market segment and then to aggregate the results to a national basis.

Figure C.4 shows the basic organization of worksheet Calc_Savings. Columns C through J contain a formatted product summary table, with equipment price and efficiency values at the top of the table and the resulting energy savings, LCC, and NPV metrics below. The equipment price and efficiency (input) assumptions are transferred into this worksheet via a copy values macro from worksheet CurrentProduct.

The spreadsheet processes seven different efficiency levels—the value of the efficiency level counter is shown in cell A11. Looping through the efficiency level is controlled by a VB procedure (although the

Column A	Columns C:J	Columns M:BK	Columns BL:CQ
Temporary Results	Product Summary Table	Data arrays to estimate distribution matrix to weight market segments	Product shipments by year FLEOH (weighted for replacement & new)
	Inputs (from CurrentProduct)		Units installed by market segment National Energy Consumption
	Outputs (transferred to CurrentProduct)		Unit Energy Consumption
	Change in life-cycle cost by market segment		Life-cycle cost by market segment Investment performance, re: 2010

Figure C.4. Data Organization in Worksheet Calc_Savings

user can actually change the value in cell A11 and observe all of the intermediate results for that efficiency level). For each efficiency level, the *hourly* unit energy consumption is placed in a cell in column A (cell A59). This value is transferred to the rightmost section of the table to calculate *annual* unit energy consumption for each year. Annual consumption depends upon the number of FLEOH for that product. The FLEOH are linked to worksheet FLEOHChoice.

The rightmost section of the table aggregates the energy consumption by market segment to the national level and cumulates the energy consumption to the 2004-2030 time frame. The resulting values are transferred back to column A. Using the conditional updating method described in Section B.5.1 above, these values are then placed into the appropriate column associated with the chosen efficiency level.

The middle portion of Calc_Savings (columns M:BK) is almost entirely devoted to constructing matrices that are used to weight the annual consumption for each market segment. Separate matrices are constructed for both replacement and new portions of national shipments. More detailed documentation of the various arrays is contained in the upper left portion of this part of the worksheet. This part of worksheet does not vary as the model loops through the efficiency levels.

After efficiency level 7 has been processed, another VB procedure copies the results section of the product summary table in Calc_Savings back to the corresponding section of the product summary table in worksheet CurrentProduct. Thus, for a casual user, there is no need to examine the results in Calc_Savings.

f) ProductData

This worksheet stores default efficiency and cost data by product. Based upon the choice of product via the variable *product_code*, the appropriate input data for that product (capacity, lifetime, efficiency ratings, and equipment prices) are copied to a data input section within the worksheet, identical to the form shown of the top of the product summary table. In auto mode, VB code then copies these inputs from the top of ProductData worksheet to the top of the CurrentProduct worksheet.

The default product data are stored by rows starting in column AY. The leftmost portion of each row consists of the following entries: 1) product code name, product description (i.e., a more complete name), fuel type (E, G, or O), equipment (output) capacity in Btu/hour, product lifetime, and 1999 estimated shipments. To the right of these values are six sets of four values. In each set the following entries are shown: 1) efficiency level name, 2) efficiency (EER or thermal efficiency), standby loss (Btu/h), and 4) contractor cost. The six sets are arranged in a consistent order beginning with EPCA 1992, Standard 90.1-1999, and then followed by four levels of increasing efficiency. (The “market baseline” efficiency shown in the product summary table was not specified as part of the default data.)

In the same manner as many of the worksheets, the data associated with the current product or set of products is moved to the top of the spreadsheet. For the ProductData worksheet, all data associated with the current product class (i.e., cooling equipment , heating equipment, or water heating equipment) is moved as an array beginning in row 8 (and column AY). This choice is controlled by the named variable product_class_code. This variable is changed by means of the user putting an “x” for the desired set of products in worksheet SelectProducts (the variable itself is contained in cell N4 of that worksheet). As stated earlier in Section C.5.1, the product class codes are simply: cooling products = 1, heating products = 2, and water heating products = 3. The available data sets in ProductData are identified in terms of product class codes that appear in column AW. A MATCH function in cell AW3 indicates the starting row in the overall named array (product_data_input—contains data for all of the default data sets) for which the requested data reside. Several alternative default sets of data are included in the named array product_data_input, but they will not be used unless the first row (in column AW) is changed to 1, 2, or 3.

The currently selected matrix of input data for the chosen product class is translated to a location to the left—the upper left entry in cell AY8 is linked to cell O16. Using a VLOOKUP function, the information for the specific *product* is then transferred to row 10. Thus, the data for the current product ends up in a row vector, O10:AJ10.

g) SalesForecasts

This worksheet extrapolates estimates of national shipments for all products, including estimated share that are replacement vs. new. The model applies simple growth rates to the estimates of 1999 shipments from worksheet ProductData.

The base year (1999) shipments from ProductData are highlighted in dark green in column G, beginning in row 13. To the right are the extrapolated values for 2000, 2005, 2010, 2020, and 2020. At the top of this section are the user-defined growth rates between each pair of the these years. The growth rates are in the vector defined in range H8:G8.

To the right of this section are the values for all years 2000 through 2030 (columns N through AS). The values for the “non-even” years (i.e., 2013) are obtained by simple linear interpolation. At the top of this section are three rows (4,5, and 6) that give total shipments, replacement shipments, and shipments to new buildings for the product currently being analyzed.

The split between replacement and new shipments is based upon a user-specified value for each product. These values are placed in column F and are highlighted in light green to denote their nature as user-specified assumptions.

h) FloorSpace

This worksheet computes the distributions of commercial building floor space by (modified) census division and building type. Two arrays at the top of the spreadsheet are highlighted in green to denote input values. In the array G7:M18 are the AEO 1999 projections of floor space (in millions of square feet) by (modified) census division for 2004. In the array to the right (cells T7:Z17) are the projections of floor space additions, summed over the period 2011-2020. The initial source of these values was a special run of the National Energy Modeling System (NEMS) that modified the commercial module to output the commercial floor space stock and additions for all years. These values were subsequently adjusted for several building types as described in Appendix B.

Distributions showing the percentage of floor space by region for each building type are shown in the rows immediately below the two input arrays. These arrays help to show the extent of regional shifts in construction, suggested by the differences between the 2004 stock values and the values associated with projected construction between 2011 and 2020.

The final set of rows (41 through 52) show the distributions normalized such that the sum of all entries equals 1000 (square feet). These arrays are used in the Calc_Savings worksheet as in input to the estimated distribution of national shipments for each product.

i) EquipShares

Worksheet EquipShares contains logic to select the appropriate equipment shares matrix for the product that the spreadsheet is currently processing. The elements of the equipment shares matrices are estimates of the fractions of floor space served by a particular type of equipment.

The structure of EquipShares is very similar to the structure of worksheet FLEOH_choice. Column B contains a list of products (code names) covered in the screening analysis. To the right of each entry in column B is the name of the FLEOH matrix that is to be used in the analysis for that product. Generic matrices are used for the cooling and heating products, primarily based upon information from the 1995 CBECS. For water heating products, a separate FLEOH matrix was developed for each product.

The equipment shares matrices are organized in a stacked fashion in columns H through Q. The matrix associated with the current product is brought to the top of the spreadsheet (in the same columns), using the logic described in the first part of Section C.4.1. The current product code is shown in cell B6 while the name of the selected equipment shares matrix is shown is cell C6. The names of the available matrices are in column F, aligned with the first row of each equipment shares matrix.

The general source of the equipment shares matrices in this worksheet is from the 1995 CBECS (EIA 1995). These matrices are developed in a separate worksheet (cbecsequip.xls). There are no other externally supplied data to the worksheet.

The user has the ability to alter the selection of the equipment shares associated with any specific product by simply altering the name of the matrix in column B. Currently, the named arrays would have to be modified to permit additional choices of equipment shares arrays. The user, however, can modify the selected equipment shares matrix within worksheet CurrentProduct.

j) FLEOH

Worksheet FLEOH contains the FLEOH for particular types of load (cooling, heating, water heating). The worksheet starts with city by building type FLEOH from the BLAST building energy simulations for cooling and heating; these values are placed in columns C through M. They are then multiplied by aggregated weights for climate regions (from Barwig et al. 1996) which are located in the columns immediately to the right. The resulting matrix products are shown in columns AC through AM.

In columns AP through AW normalizing multipliers for economizer and setback use from 1995 CBECS are shown, which are applied to the cooling and heating FLEOH in columns AZ through BG. The sum of the normalized cooling, boiler, and furnace FLEOH appear in columns BJ through BR. For cooling and heating products, with the exception of boilers, the final FLEOH appear in teal colored matrices in columns BJ through BR. A final multiplier to adjust for boiler standby loss is applied o the boiler FLEOH with the resulting matrix a teal colored table in the array CD69:CL84. The final teal colored matrices are linked (as inputs to) worksheet FLEOH_Choice.

k) FLEOH_Choice

Worksheet FLEOH_Choice contains logic to select the appropriate FLEOH matrix for the product that the spreadsheet is currently processing. Column B contains a list of products (code names) covered in the screening analysis. To the right of each entry in column B is the name of the FLEOH matrix that is to be used in the analysis for that product. Generic matrices are used for the cooling and heating products. For water heating products, a separate FLEOH matrix was developed for each product.

The FLEOH matrices are organized in a stacked fashion in columns H through Q. The matrix associated with the current product is brought to the top of the spreadsheet (in the same columns), using the logic described in the first part of Section C.4.1. The current product code is shown in cell B6 while the name of the selected FLEOH matrix is shown is cell C6. The names of the available matrices are in column F, aligned with the first row of each FLEOH matrix.

The source of the FLEOH matrices in this worksheet is from the worksheet FLEOH. There is no other externally supplied data to the worksheet.

The user has the ability to alter the selection of the FLEOH associated with any specific product by simply altering the name of the matrix in column B. Currently, the named arrays would have to be modified to permit additional choices of FLEOH arrays.

l)   Peak_Cap

Peak Load Intensities (kBtu/h-ft^2) that influence the number of sales in each market segment. [These values were not used in the screening analysis -- in this worksheet they are all set equal to 1.0]

m) EnergyPrices

The EnergyPrices worksheet selects an array of either electricity or gas prices depending upon the product. The energy price arrays from this worksheet are organized by (modified) census division and for years 2000 through 2060. The years 2031 through 2060 are needed to compute LCC for boilers, whose lifetimes are set at 30 years.

Energy prices by census division from 2000 through 2020 are taken directly from the Annual Energy Outlook 2000 (EIA 1999b). The prices from the AEO are expressed in 98$ per million Btu and are highlighted in green.

Above each set of prices (electricity, gas, distillate) from the AEO is an array that converts the prices to more natural units (cents/kWh for electricity) as well as making estimates of prices for the break-out north and south regions of the Mountain and Pacific census regions. Moreover, any user-requested multiplicative or additive adjustment factor is applied.

The named variable fuel_prices, set at the top of worksheet CurrentProduct, is used to select the appropriate array of fuel prices and move them to the top of worksheet EnergyPrices. The moving of the requested array is accomplished by means of an OFFSET function in each cell in the current set of energy prices.

n)   SourceConversion

The SourceConversion worksheet selects the appropriate vector of factors to convert delivered energy to primary energy for each fuel. The worksheet is adapted from a similar one used in the National Energy Savings spreadsheet for residential water heater standards. For electricity, conversion factors are calculated from the projections of delivered and primary energy in the AEO 2000—for years 1998, 2005, 2010, 2015, and 2020 (EIA 1999a). The projected energy consumption values from the AEO are highlighted in green in columns D and E in the upper left hand portion of the table. In column C, the values are interpolated for intervening years.

The conversion factors are transposed to rows to the right of the spreadsheet. The selection of which row is actually used in the calculation is made with a CHOOSE function in row 6.

o) Emissions Factors

This worksheet translates energy consumption by fuel into estimates in environmental emissions. The primary input data is a set of projected emissions conversion factors by year (MMtons per trillion Btu of *delivered* energy) taken from an access database used in the Building Energy Savings Estimation Tool (BESET) developed by PNNL for the Office of Building Technologies, State and Community Programs as part of the GPRA metrics program. These values were originally provided by the Office of Energy Efficiency and Renewable Energy (EERE) of the U.S. Department of Energy (see Section 3.3.4 for further details [DOE 1999]). These input values are shown in bright green to denote they come from an external source.

In worksheet EmissionsFactors, the emissions for factors for carbon and NO_x, for three fuels—electricity, natural gas, and oil—are transposed to rows beginning in column X. These six rows of data are shown in rows 15 through 20 in this portion of the worksheet. In rows 8 through 13, a multiplicative adjustment is made to the emissions factors for natural gas and oil. This adjustment ensures that the total emissions savings are appropriate to the total (primary) energy savings for these fuels (as calculated in Calc_Savings). Following the same procedure as the energy conversion factors, a CHOOSE function is used to select the pair of emissions factors (carbon, NO_x) corresponding to the fuel for the current product. The selected pair of rows is copied to rows 4 and 5 at the top of the worksheet.

p) ProdTable

ProdTable contains a copy of the product summary table that is generated in sheet CurrentProduct. This worksheet can be copied to a user file for storage of results either manually, or by selecting the "Save product tables in an output file?" option in the SelectProducts worksheet prior to initiating the analysis.

C.6 References

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Appendix D

D Summary Results for all Products Analyzed

Product:	**3-Phase Single Package, Air Source AC, <65 kBtu/h**						
Output Capacity (Btu/hr)	60,000			Estimated Shipments in 1999			213,728
Lifetime (years)	15			Projected Shipments, 2004-2030			6,859,279
Equip. Price Markup	25%						
Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	TestLevel1	TestLevel2	Upgrade Group	MaxAvail
EER	9.7	9.7	9.7	11.0	12.0	13.0	15.0
Standby Loss (NA)	0	0	0	0	0	0	0
Equip. Price (w/o markup)	$2,128	$2,128	$2,128	$2,533	$2,767	$3,469	$4,746
Equip. Price (w/ markup)	$2,660	$2,660	$2,660	$3,166	$3,458	$4,336	$5,932
Year of Standard	NA	NA	2004	2004	2004	2004	2004
LIFE CYCLE COST (LCC) SAVINGS, for 2010				**1998 Dollars per Unit**			
Savings relative to EPCA 1992							
Weighted Average LCC Savings			$0	$217	$374	-$123	-$1,111
Max LCC Savings			$0	$1,220	$2,000	$2,030	$1,886
Min LCC Savings			$0	-$337	-$525	-$1,315	-$2,770
Percentage of units with LCC savings > 0			100.0%	71.1%	78.0%	39.1%	8.5%
NATIONAL ENERGY SAVINGS				**Trillion Btu (Primary)**			
Relative to EPCA 1992							
2010			0.0	20.0	32.4	42.9	59.7
2020			0.0	43.2	70.0	92.7	129.0
2030			0.0	45.2	73.3	97.0	135.1
2004-2030			0.0	871.1	1,412.7	1,871.0	2,604.3
Relative to Standard 90.1-1999							
2010				20.0	32.4	42.9	59.7
2020				43.2	70.0	92.7	129.0
2030				45.2	73.3	97.0	135.1
2004-2030				871.1	1,412.7	1,871.0	2,604.3
EMISSIONS REDUCTIONS (2004-2030)				**Million Metric Tons**			
Relative to EPCA 1992							
Carbon Equivalent			0.0	12.8	20.8	27.5	38.3
NOx			0.00	0.12	0.19	0.25	0.34
Relative to Standard 90.1-1999							
Carbon Equivalent				12.8	20.8	27.5	38.3
NOx				0.12	0.19	0.25	0.34
NET PRESENT VALUE (NPV) @ Discount Rate of		7.0%		**Million 1998 Dollars**			
Relative to EPCA 1992			$0.0	$521.6	$897.7	-$290.6	-$2,649.5
Relative to Standard 90.1-1999				$521.6	$897.7	-$290.6	-$2,649.5
Adjust AEO Fuel Prices:	Multiplier:	1.05	Adder ($/kWh):		$0.000		
Report created:	3/31/00 10:44 AM						

Product:	3-Phase Single Package, Air Source AC, <65 kBtu/h				*Supplemental Results*		
Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	TestLevel1	TestLevel2	Upgrade Group	MaxAvail
EER	9.7	9.7	9.7	11.0	12.0	13.0	15.0
			Key Results: Per Unit Basis				
Input Capacity (kW)	6.186	6.186	6.186	5.455	5.000	4.615	4.000
National Ave FLEOH	1,622.5	1,622.5	1,622.5	1,622.5	1,622.5	1,622.5	1,622.5
Life-Cycle Costs: 1) wgted market segments , 2) w/nat. ave. energy price					2010 Ave. Energy Price=		$0.067
1) Wgted LCC	$8,777	$8,777	$8,777	$8,560	$8,403	$8,900	$9,888
2) LCC/ave energy price	$8,656	$8,656	$8,656	$8,452	$8,305	$8,810	$9,809
Measures of Investment Performance For Efficiency Levels Exceeding EPCA 1992 (for Year 2010)							
Based on National Average Values for Unit Consumption and Energy Price--Relative to EPCA 1992							
	Payback Period (yrs)		NA	6.4	6.2	9.8	13.8
	Cost of Saved Energy ($/kWh)		NA	$0.047	$0.046	$0.072	$0.101
	NPV (= LCC Savings) ($)		$0	$203	$351	-$154	-$1,154
	Internal Rate of Return		NA	12.9%	13.4%	5.5%	0.8%
Based on National Average Values for Unit Consumption and Energy Price--Relative to Standard 90.1-1999							
	Payback Period (yrs)		NA	6.4	6.2	9.8	13.8
	Cost of Saved Energy ($/kWh)		NA	$0.047	$0.046	$0.072	$0.101
	NPV (= LCC Savings) ($)		$0	$203	$351	-$154	-$1,154
	Internal Rate of Return		NA	12.9%	13.4%	5.5%	0.8%
	Break-even cost multiplier			1.402	1.440	0.908	0.647
		Aggregate Measures					
National Energy Consumption			**Trillion Btu (Primary)**				
2010	168.9	168.9	168.9	148.9	136.5	126.0	109.2
2020	365.2	365.2	365.2	322.1	295.2	272.5	236.2
2030	382.3	382.3	382.3	337.1	309.0	285.2	247.2
Cumulative, 2004-2030	7,370.6	7,370.6	7,370.6	6,499.5	5,957.9	5,499.6	4,766.3
Emissions			**Million Metric Tons**				
Carbon (MMtons)	113.1	113.1	113.1	100.2	92.3	85.5	74.7
NOX (MMtons)	1.0	1.0	1.0	0.9	0.8	0.8	0.7
Discounted LCC for Nation			**Millions of 1998 $**				
from Market Segments	28,084.6	28,084.6	28,084.6	27,563.1	27,187.0	28,375.2	30,734.1
National NPV							
Relative to EPCA 1992			0.0	521.6	897.7	-290.6	-2,649.5
Relative to 90.1-1999				521.6	897.7	-290.6	-2,649.5

Quick Calc with National Averages (2010) ***(Note: Energy price fixed at 2010 value)***

Energy Price ($/kWh),	$0.067	$0.067	$0.067	$0.067	$0.067	$0.067	$0.067
Ann. energy use (kWh)	10,036	10,036	10,036	8,850	8,112	7,488	6,490
Standby Losses (kWh)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy cost, $/yr	$671	$671	$671	$591	$542	$500	$434
PV (energy cost)	$6,109	$6,109	$6,109	$5,387	$4,938	$4,558	$3,950
Equipment Cost	$2,660	$2,660	$2,660	$3,166	$3,458	$4,336	$5,932
Unit LCC	$8,769	$8,769	$8,769	$8,553	$8,396	$8,894	$9,883
Report created:	3/31/00 10:44 AM						

Product: **3-Phase Single Package, Air Source HP, <65 kBtu/h**

Output Capacity (Btu/hr)	60,000	Estimated Shipments in 1999	27,773
Lifetime (years)	15	Projected Shipments, 2004-2030	891,319
Equip. Price Markup	25%		

Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	TestLevel1	TestLevel2	Upgrade Group	MaxAvail
EER	9.7	9.7	9.7	11.0	12.0	13.0	15.0
Standby Loss (NA)	0	0	0	0	0	0	0
Equip. Price (w/o markup)	$2,513	$2,513	$2,513	$2,865	$3,217	$4,021	$5,353
Equip. Price (w/ markup)	$3,142	$3,142	$3,142	$3,581	$4,021	$5,026	$6,691
Year of Standard	NA	NA	2004	2004	2004	2004	2004

LIFE CYCLE COST (LCC) SAVINGS, for 2010			**1998 Dollars per Unit**			
Savings relative to EPCA 1992						
Weighted Average LCC Savings		$0	$283	$293	-$332	-$1,389
Max LCC Savings		$0	$1,285	$1,918	$1,821	$1,608
Min LCC Savings		$0	-$272	-$607	-$1,524	-$3,047
Percentage of units with LCC savings > 0		100.0%	81.9%	68.5%	27.3%	7.2%

NATIONAL ENERGY SAVINGS		**Trillion Btu (Primary)**			
Relative to EPCA 1992					
2010	0.0	2.6	4.2	5.6	7.8
2020	0.0	5.6	9.1	12.0	16.8
2030	0.0	5.9	9.5	12.6	17.6
2004-2030	0.0	113.2	183.6	243.1	338.4
Relative to Standard 90.1-1999					
2010		2.6	4.2	5.6	7.8
2020		5.6	9.1	12.0	16.8
2030		5.9	9.5	12.6	17.6
2004-2030		113.2	183.6	243.1	338.4

EMISSIONS REDUCTIONS (2004-2030)		**Million Metric Tons**			
Relative to EPCA 1992					
Carbon Equivalent	0.0	1.7	2.7	3.6	5.0
NOx	0.00	0.01	0.02	0.03	0.04
Relative to Standard 90.1-1999					
Carbon Equivalent		1.7	2.7	3.6	5.0
NOx		0.01	0.02	0.03	0.04

NET PRESENT VALUE (NPV) @ Discount Rate of	7.0%		**Million 1998 Dollars**			
Relative to EPCA 1992		$0.0	$88.2	$91.3	-$102.7	-$430.6
Relative to Standard 90.1-1999			$88.2	$91.3	-$102.7	-$430.6

Adjust AEO Fuel Prices:	Multiplier:	1.05	Adder ($/kWh):	$0.000
Report created:	3/31/00 10:44 AM			

Product:	3-Phase Single Package, Air Source HP, <65 kBtu/h				*Supplemental Results*		
Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	TestLevel1	TestLevel2	Upgrade Group	MaxAvail
EER	9.7	9.7	9.7	11.0	12.0	13.0	15.0
			Key Results: Per Unit Basis				
Input Capacity (kW)	6.186	6.186	6.186	5.455	5.000	4.615	4.000
National Ave FLEOH	1,622.5	1,622.5	1,622.5	1,622.5	1,622.5	1,622.5	1,622.5
Life-Cycle Costs: 1) wgted market segments , 2) w/nat. ave. energy price					2010 Ave. Energy Price=		$0.067
1) Wgted LCC	$9,258	$9,258	$9,258	$8,975	$8,966	$9,591	$10,647
2) LCC/ave energy price	$9,137	$9,137	$9,137	$8,868	$8,867	$9,500	$10,568
Measures of Investment Performance For Efficiency Levels Exceeding EPCA 1992 (for Year 2010)							
Based on National Average Values for Unit Consumption and Energy Price--Relative to EPCA 1992							
Payback Period (yrs)			NA	5.5	6.8	11.1	15.0
Cost of Saved Energy ($/kWh)			NA	$0.041	$0.050	$0.081	$0.110
NPV (= LCC Savings) ($)			$0	$269	$269	-$363	-$1,432
Internal Rate of Return			NA	15.7%	11.6%	3.8%	-0.2%
Based on National Average Values for Unit Consumption and Energy Price--Relative to Standard 90.1-1999							
Payback Period (yrs)			NA	5.5	6.8	11.1	15.0
Cost of Saved Energy ($/kWh)			NA	$0.041	$0.050	$0.081	$0.110
NPV (= LCC Savings) ($)			$0	$269	$269	-$363	-$1,432
Internal Rate of Return			NA	15.7%	11.6%	3.8%	-0.2%
Break-even cost multiplier				1.611	1.306	0.807	0.597
			Aggregate Measures				
National Energy Consumption			**Trillion Btu (Primary)**				
2010	21.9	21.9	21.9	19.4	17.7	16.4	14.2
2020	47.5	47.5	47.5	41.9	38.4	35.4	30.7
2030	49.7	49.7	49.7	43.8	40.2	37.1	32.1
Cumulative, 2004-2030	957.8	957.8	957.8	844.6	774.2	714.6	619.4
Emissions				**Million Metric Tons**			
Carbon (MMtons)	14.7	14.7	14.7	13.0	12.0	11.1	9.7
NOX (MMtons)	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Discounted LCC for Nation				**Millions of 1998 $**			
from Market Segments	3,848.0	3,848.0	3,848.0	3,759.9	3,756.7	3,950.7	4,278.6
National NPV							
Relative to EPCA 1992			0.0	88.2	91.3	-102.7	-430.6
Relative to 90.1-1999				88.2	91.3	-102.7	-430.6

Quick Calc with National Averages (2010) ***(Note: Energy price fixed at 2010 value)***

Energy Price ($/kWh),	$0.067	$0.067	$0.067	$0.067	$0.067	$0.067	$0.067
Ann. energy use (kWh)	10,036	10,036	10,036	8,850	8,112	7,488	6,490
Standby Losses (kWh)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy cost, $/yr	$671	$671	$671	$591	$542	$500	$434
PV (energy cost)	$6,109	$6,109	$6,109	$5,387	$4,938	$4,558	$3,950
Equipment Cost	$3,142	$3,142	$3,142	$3,581	$4,021	$5,026	$6,691
Unit LCC	$9,250	$9,250	$9,250	$8,968	$8,959	$9,585	$10,642
Report created:	3/31/00 10:44 AM						

Product: **3-Phase Split, Air Source AC, <65 kBtu/h**

Output Capacity (Btu/hr)	60,000		Estimated Shipments in 1999	91,598
Lifetime (years)	15		Projected Shipments, 2004-2030	2,939,691
Equip. Price Markup	25%			

Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	TestLevel1	TestLevel2	Upgrade Group	MaxAvail
EER	10.0	10.0	10.0	11.0	12.0	13.0	15.0
Standby Loss (NA)	0	0	0	0	0	0	0
Equip. Price (w/o markup)	$2,167	$2,167	$2,167	$2,514	$2,948	$3,533	$5,202
Equip. Price (w/ markup)	$2,709	$2,709	$2,709	$3,143	$3,685	$4,416	$6,502
Year of Standard	NA	NA	2004	2004	2004	2004	2004

LIFE CYCLE COST (LCC) SAVINGS, for 2010		**1998 Dollars per Unit**			
Savings relative to EPCA 1992					
Weighted Average LCC Savings	$0	$106	$14	-$338	-$1,815
Max LCC Savings	$0	$854	$1,385	$1,561	$927
Min LCC Savings	$0	-$308	-$745	-$1,389	-$3,333
Percentage of units with LCC savings > 0	100.0%	64.1%	47.1%	27.3%	1.9%
NATIONAL ENERGY SAVINGS		**Trillion Btu (Primary)**			
Relative to EPCA 1992					
2010	0.0	6.4	11.7	16.2	23.4
2020	0.0	13.8	25.3	35.0	50.6
2030	0.0	14.4	26.5	36.7	53.0
2004-2030	0.0	278.6	510.7	707.1	1,021.4
Relative to Standard 90.1-1999					
2010		6.4	11.7	16.2	23.4
2020		13.8	25.3	35.0	50.6
2030		14.4	26.5	36.7	53.0
2004-2030		278.6	510.7	707.1	1,021.4
EMISSIONS REDUCTIONS (2004-2030)		**Million Metric Tons**			
Relative to EPCA 1992					
Carbon Equivalent	0.0	4.1	7.5	10.4	15.0
NOx	0.00	0.04	0.07	0.09	0.14
Relative to Standard 90.1-1999					
Carbon Equivalent		4.1	7.5	10.4	15.0
NOx		0.04	0.07	0.09	0.14
NET PRESENT VALUE (NPV) @ Discount Rate of 7.0%		**Million 1998 Dollars**			
Relative to EPCA 1992	$0.0	$109.1	$14.9	-$344.4	-$1,857.4
Relative to Standard 90.1-1999		$109.1	$14.9	-$344.4	-$1,857.4

Adjust AEO Fuel Prices:	Multiplier:	1.05	Adder ($/kWh):	$0.000
Report created:	3/31/00 10:45 AM			

Product:	3-Phase Split, Air Source AC, <65 kBtu/h				*Supplemental Results*		
Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	TestLevel1	TestLevel2	Upgrade Group	MaxAvail
EER	10.0	10.0	10.0	11.0	12.0	13.0	15.0
			Key Results: Per Unit Basis				
Input Capacity (kW)	6.000	6.000	6.000	5.455	5.000	4.615	4.000
National Ave FLEOH	1,622.5	1,622.5	1,622.5	1,622.5	1,622.5	1,622.5	1,622.5
Life-Cycle Costs: 1) wgted market segments , 2) w/nat. ave. energy price					2010 Ave. Energy Price=		$0.067
1) Wgted LCC	$8,643	$8,643	$8,643	$8,537	$8,629	$8,980	$10,458
2) LCC/ave energy price	$8,525	$8,525	$8,525	$8,430	$8,531	$8,890	$10,379
Measures of Investment Performance For Efficiency Levels Exceeding EPCA 1992 (for Year 2010)							
Based on National Average Values for Unit Consumption and Energy Price--Relative to EPCA 1992							
Payback Period (yrs)			NA	7.3	9.0	11.4	17.5
Cost of Saved Energy ($/kWh)			NA	$0.054	$0.066	$0.083	$0.128
NPV (= LCC Savings) ($)			$0	$95	-$6	-$365	-$1,855
Internal Rate of Return			NA	10.3%	6.9%	3.4%	-2.1%
Based on National Average Values for Unit Consumption and Energy Price--Relative to Standard 90.1-1999							
Payback Period (yrs)			NA	7.3	9.0	11.4	17.5
Cost of Saved Energy ($/kWh)			NA	$0.054	$0.066	$0.083	$0.128
NPV (= LCC Savings) ($)			$0	$95	-$6	-$365	-$1,855
Internal Rate of Return			NA	10.3%	6.9%	3.4%	-2.1%
Break-even cost multiplier				1.220	0.994	0.786	0.511
		Aggregate Measures					
National Energy Consumption			**Trillion Btu (Primary)**				
2010	70.2	70.2	70.2	63.8	58.5	54.0	46.8
2020	151.8	151.8	151.8	138.0	126.5	116.8	101.2
2030	158.9	158.9	158.9	144.5	132.4	122.2	105.9
Cumulative, 2004-2030	3,064.1	3,064.1	3,064.1	2,785.5	2,553.4	2,357.0	2,042.7
Emissions			**Million Metric Tons**				
Carbon (MMtons)	47.0	47.0	47.0	42.9	39.5	36.6	32.0
NOX (MMtons)	0.4	0.4	0.4	0.4	0.4	0.3	0.3
Discounted LCC for Nation			**Millions of 1998 $**				
from Market Segments	11,850.7	11,850.7	11,850.7	11,741.6	11,835.8	12,195.1	13,708.0
National NPV							
Relative to EPCA 1992			0.0	109.1	14.9	-344.4	-1,857.4
Relative to 90.1-1999				109.1	14.9	-344.4	-1,857.4

Quick Calc with National Averages (2010) ***(Note: Energy price fixed at 2010 value)***

Energy Price ($/kWh),	$0.067	$0.067	$0.067	$0.067	$0.067	$0.067	$0.067
Ann. energy use (kWh)	9,735	9,735	9,735	8,850	8,112	7,488	6,490
Standby Losses (kWh)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy cost, $/yr	$651	$651	$651	$591	$542	$500	$434
PV (energy cost)	$5,926	$5,926	$5,926	$5,387	$4,938	$4,558	$3,950
Equipment Cost	$2,709	$2,709	$2,709	$3,143	$3,685	$4,416	$6,502
Unit LCC	$8,635	$8,635	$8,635	$8,530	$8,623	$8,974	$10,453
Report created:	3/31/00 10:45 AM						

Product:	3-Phase Split, Air Source HP, <65 kBtu/h						
Output Capacity (Btu/hr)	60,000			Estimated Shipments in 1999			11,903
Lifetime (years)	15			Projected Shipments, 2004-2030			381,994
Equip. Price Markup	25%						
Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	TestLevel1	TestLevel2	Upgrade Group	MaxAvail
EER	10.0	10.0	10.0	11.0	12.0	13.0	15.0
Standby Loss (NA)	0	0	0	0	0	0	0
Equip. Price (w/o markup)	$2,123	$2,123	$2,123	$2,336	$2,633	$3,057	$4,438
Equip. Price (w/ markup)	$2,654	$2,654	$2,654	$2,919	$3,291	$3,822	$5,547
Year of Standard	NA	NA	2004	2004	2004	2004	2004
LIFE CYCLE COST (LCC) SAVINGS, for 2010				**1998 Dollars per Unit**			
Savings relative to EPCA 1992							
Weighted Average LCC Savings			$0	$274	$352	$201	-$915
Max LCC Savings			$0	$1,022	$1,723	$2,100	$1,827
Min LCC Savings			$0	-$140	-$407	-$849	-$2,433
Percentage of units with LCC savings > 0			100.0%	92.2%	81.0%	58.6%	12.4%
NATIONAL ENERGY SAVINGS				**Trillion Btu (Primary)**			
Relative to EPCA 1992							
2010			0.0	0.8	1.5	2.1	3.0
2020			0.0	1.8	3.3	4.6	6.6
2030			0.0	1.9	3.4	4.8	6.9
2004-2030			0.0	36.2	66.4	91.9	132.7
Relative to Standard 90.1-1999							
2010				0.8	1.5	2.1	3.0
2020				1.8	3.3	4.6	6.6
2030				1.9	3.4	4.8	6.9
2004-2030				36.2	66.4	91.9	132.7
EMISSIONS REDUCTIONS (2004-2030)				**Million Metric Tons**			
Relative to EPCA 1992							
Carbon Equivalent			0.0	0.5	1.0	1.4	2.0
NOx			0.00	0.00	0.01	0.01	0.02
Relative to Standard 90.1-1999							
Carbon Equivalent				0.5	1.0	1.4	2.0
NOx				0.00	0.01	0.01	0.02
NET PRESENT VALUE (NPV) @ Discount Rate of		7.0%		**Million 1998 Dollars**			
Relative to EPCA 1992			$0.0	$36.5	$47.0	$27.0	-$121.5
Relative to Standard 90.1-1999				$36.5	$47.0	$27.0	-$121.5
Adjust AEO Fuel Prices:	Multiplier:	1.05	Adder ($/kWh):		$0.000		
Report created:	3/31/00 10:46 AM						

Product:	**3-Phase Split, Air Source HP, <65 kBtu/h**				***Supplemental Results***		
Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	TestLevel1	TestLevel2	Upgrade Group	MaxAvail
EER	10.0	10.0	10.0	11.0	12.0	13.0	15.0
		Key Results: Per Unit Basis					
Input Capacity (kW)	6.000	6.000	6.000	5.455	5.000	4.615	4.000
National Ave FLEOH	1,622.5	1,622.5	1,622.5	1,622.5	1,622.5	1,622.5	1,622.5
Life-Cycle Costs: 1) wgted market segments , 2) w/nat. ave. energy price					2010 Ave. Energy Price=		$0.067
1) Wgted LCC	$8,587	$8,587	$8,587	$8,313	$8,236	$8,386	$9,503
2) LCC/ave energy price	$8,469	$8,469	$8,469	$8,206	$8,137	$8,295	$9,424
Measures of Investment Performance For Efficiency Levels Exceeding EPCA 1992 (for Year 2010)							
Based on National Average Values for Unit Consumption and Energy Price--Relative to EPCA 1992							
	Payback Period (yrs)		NA	4.5	5.9	7.8	13.3
	Cost of Saved Energy ($/kWh)		NA	$0.033	$0.043	$0.057	$0.098
	NPV (= LCC Savings) ($)		$0	$263	$332	$174	-$954
	Internal Rate of Return		NA	20.6%	14.6%	9.3%	1.2%
Based on National Average Values for Unit Consumption and Energy Price--Relative to Standard 90.1-1999							
	Payback Period (yrs)		NA	4.5	5.9	7.8	13.3
	Cost of Saved Energy ($/kWh)		NA	$0.033	$0.043	$0.057	$0.098
	NPV (= LCC Savings) ($)		$0	$263	$332	$174	-$954
	Internal Rate of Return		NA	20.6%	14.6%	9.3%	1.2%
	Break-even cost multiplier			1.992	1.522	1.149	0.670
		Aggregate Measures					
National Energy Consumption			**Trillion Btu (Primary)**				
2010	9.1	9.1	9.1	8.3	7.6	7.0	6.1
2020	19.7	19.7	19.7	17.9	16.4	15.2	13.2
2030	20.6	20.6	20.6	18.8	17.2	15.9	13.8
Cumulative, 2004-2030	398.2	398.2	398.2	362.0	331.8	306.3	265.4
Emissions			**Million Metric Tons**				
Carbon (MMtons)	6.1	6.1	6.1	5.6	5.1	4.8	4.2
NOX (MMtons)	0.1	0.1	0.1	0.1	0.0	0.0	0.0
Discounted LCC for Nation			**Millions of 1998 $**				
from Market Segments	1,530.1	1,530.1	1,530.1	1,493.6	1,483.2	1,503.1	1,651.7
National NPV							
Relative to EPCA 1992			0.0	36.5	47.0	27.0	-121.5
Relative to 90.1-1999				36.5	47.0	27.0	-121.5

Quick Calc with National Averages (2010) (Note: Energy price fixed at 2010 value)

	EPCA 1992	Market Baseline	Standard 90.1-1999	TestLevel1	TestLevel2	Upgrade Group	MaxAvail
Energy Price ($/kWh),	$0.067	$0.067	$0.067	$0.067	$0.067	$0.067	$0.067
Ann. energy use (kWh)	9,735	9,735	9,735	8,850	8,112	7,488	6,490
Standby Losses (kWh)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy cost, $/yr	$651	$651	$651	$591	$542	$500	$434
PV (energy cost)	$5,926	$5,926	$5,926	$5,387	$4,938	$4,558	$3,950
Equipment Cost	$2,654	$2,654	$2,654	$2,919	$3,291	$3,822	$5,547
Unit LCC	$8,580	$8,580	$8,580	$8,306	$8,229	$8,380	$9,497
Report created:	3/31/00 10:46 AM						

Product:	Central, Air Source AC, >=65, <135 kBtu/h						
Output Capacity (Btu/hr)	90,000			Estimated Shipments in 1999			165,000
Lifetime (years)	15			Projected Shipments, 2004-2030			5,295,440
Equip. Price Markup	25%						

Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	ARI Curve Endpoint	90.1R Tier2	Upgrade Group	MaxAvail
EER	8.9	8.9	10.3	10.5	10.8	11.0	12.5
Standby Loss (NA)	0	0	0	0	0	0	0
Equip. Price (w/o markup)	$3,195	$3,195	$3,932	$4,102	$4,392	$4,648	$8,823
Equip. Price (w/ markup)	$3,993	$3,993	$4,916	$5,127	$5,491	$5,810	$11,029
Year of Standard	NA	NA	2004	2004	2004	2004	2004
LIFE CYCLE COST (LCC) SAVINGS, for 2010			**1998 Dollars per Unit**				
Savings relative to EPCA 1992							
Weighted Average LCC Savings			$363	$307	$167	-$11	-$4,311
Max LCC Savings			$2,322	$2,503	$2,701	$2,739	$0
Min LCC Savings			-$645	-$823	-$1,139	-$1,428	-$6,449
Percentage of units with LCC savings > 0			70.1%	63.7%	58.0%	44.2%	0.0%
NATIONAL ENERGY SAVINGS			**Trillion Btu (Primary)**				
Relative to EPCA 1992							
2010			27.4	30.8	35.5	38.5	58.2
2020			59.4	66.5	76.8	83.4	125.8
2030			62.1	69.6	80.4	87.3	131.6
2004-2030			1,197.9	1,342.9	1,550.4	1,682.5	2,538.1
Relative to Standard 90.1-1999							
2010				3.3	8.1	11.1	30.7
2020				7.2	17.5	24.0	66.4
2030				7.5	18.3	25.1	69.5
2004-2030				145.0	352.5	484.6	1,340.2
EMISSIONS REDUCTIONS (2004-2030)			**Million Metric Tons**				
Relative to EPCA 1992							
Carbon Equivalent			17.6	19.8	22.8	24.8	37.3
NOx			0.16	0.18	0.21	0.22	0.34
Relative to Standard 90.1-1999							
Carbon Equivalent				2.1	5.2	7.1	19.7
NOx				0.02	0.05	0.06	0.18
NET PRESENT VALUE (NPV) @ Discount Rate of		7.0%	**Million 1998 Dollars**				
Relative to EPCA 1992			$673.2	$570.3	$311.2	-$16.4	-$7,950.0
Relative to Standard 90.1-1999				-$102.9	-$362.0	-$689.6	-$8,623.1
Adjust AEO Fuel Prices:	Multiplier:	1.05	Adder ($/kWh):		$0.000		
Report created:	3/31/00 10:46 AM						

Product:	Central, Air Source AC, >=65, <135 kBtu/h				*Supplemental Results*		
Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	ARI Curve Endpoint	90.1R Tier2	Upgrade Group	MaxAvail
EER	8.9	8.9	10.3	10.5	10.8	11.0	12.5
		Key Results: Per Unit Basis					
Input Capacity (kW)	10.112	10.112	8.738	8.571	8.333	8.182	7.200
National Ave FLEOH	1,537.1	1,537.1	1,537.1	1,537.1	1,537.1	1,537.1	1,537.1
Life-Cycle Costs: 1) wgted market segments , 2) w/nat. ave. energy price					2010 Ave. Energy Price=		$0.067
1) Wgted LCC	$13,453	$13,453	$13,090	$13,146	$13,286	$13,464	$17,765
2) LCC/ave energy price	$13,279	$13,279	$12,939	$12,998	$13,143	$13,323	$17,640
Measures of Investment Performance For Efficiency Levels Exceeding EPCA 1992 (for Year 2010)							
Based on National Average Values for Unit Consumption and Energy Price--Relative to EPCA 1992							
Payback Period (yrs)			6.5	7.2	8.2	9.2	23.5
Cost of Saved Energy ($/kWh)			$0.048	$0.053	$0.060	$0.067	$0.173
NPV (= LCC Savings) ($)			$340	$281	$136	-$44	-$4,362
Internal Rate of Return			12.5%	10.7%	8.4%	6.6%	-5.4%
Based on National Average Values for Unit Consumption and Energy Price--Relative to Standard 90.1-1999							
Payback Period (yrs)			NA	12.4	13.8	15.7	38.7
Cost of Saved Energy ($/kWh)			NA	$0.091	$0.102	$0.115	$0.284
NPV (= LCC Savings) ($)			$0	-$59	-$204	-$384	-$4,701
Internal Rate of Return			NA	2.2%	0.8%	-0.8%	NA
Break-even cost multiplier				0.722	0.646	0.571	0.231
		Aggregate Measures					
National Energy Consumption			**Trillion Btu (Primary)**				
2010	201.9	201.9	174.5	171.1	166.4	163.4	143.8
2020	436.7	436.7	377.3	370.2	359.9	353.3	310.9
2030	457.1	457.1	394.9	387.4	376.7	369.8	325.4
Cumulative, 2004-2030	8,812.9	8,812.9	7,615.0	7,470.0	7,262.5	7,130.4	6,274.8
Emissions				**Million Metric Tons**			
Carbon (MMtons)	135.2	135.2	117.6	115.4	112.4	110.4	97.8
NOX (MMtons)	1.2	1.2	1.1	1.0	1.0	1.0	0.9
Discounted LCC for Nation				**Millions of 1998 $**			
from Market Segments	33,234.7	33,234.7	32,561.6	32,664.5	32,923.5	33,251.1	41,184.7
National NPV							
Relative to EPCA 1992			673.2	570.3	311.2	-16.4	-7,950.0
Relative to 90.1-1999				-102.9	-362.0	-689.6	-8,623.1

Quick Calc with National Averages (2010) (Note: Energy price fixed at 2010 value)

Energy Price ($/kWh),	$0.067	$0.067	$0.067	$0.067	$0.067	$0.067	$0.067
Ann. energy use (kWh)	15,544	15,544	13,431	13,175	12,809	12,576	11,067
Standby Losses (kWh)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy cost, $/yr	$1,039	$1,039	$898	$881	$856	$840	$740
PV (energy cost)	$9,461	$9,461	$8,175	$8,020	$7,797	$7,655	$6,736
Equipment Cost	$3,993	$3,993	$4,916	$5,127	$5,491	$5,810	$11,029
Unit LCC	$13,455	$13,455	$13,091	$13,147	$13,287	$13,465	$17,766
Report created:	3/31/00 10:46 AM						

Product:	**Central, Air Source HP, >=65, <135 kBtu/h**						
Output Capacity (Btu/hr)	90,000			Estimated Shipments in 1999			17,000
Lifetime (years)	15			Projected Shipments, 2004-2030			545,591
Equip. Price Markup	25%						
Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	ARI Curve Endpoint	90.1R Tier2	Upgrade Group	MaxAvail
EER	8.9	8.9	10.1	10.5	10.6	11.0	11.7
Standby Loss (NA)	0	0	0	0	0	0	0
Equip. Price (w/o markup)	$4,090	$4,090	$4,958	$5,485	$5,637	$6,524	$9,220
Equip. Price (w/ markup)	$5,113	$5,113	$6,197	$6,857	$7,046	$8,155	$11,525
Year of Standard	NA	NA	2004	2004	2004	2004	2004
LIFE CYCLE COST (LCC) SAVINGS, for 2010				**1998 Dollars per Unit**			
Savings relative to EPCA 1992							
Weighted Average LCC Savings			$40	-$302	-$416	-$1,236	-$4,148
Max LCC Savings			$1,752	$1,893	$1,895	$1,514	$0
Min LCC Savings			-$842	-$1,433	-$1,606	-$2,653	-$5,924
Percentage of units with LCC savings > 0			48.1%	29.2%	26.6%	7.2%	0.0%
NATIONAL ENERGY SAVINGS				**Trillion Btu (Primary)**			
Relative to EPCA 1992							
2010			2.5	3.2	3.3	4.0	5.0
2020			5.3	6.9	7.2	8.6	10.8
2030			5.6	7.2	7.6	9.0	11.3
2004-2030			107.9	138.4	145.6	173.3	217.3
Relative to Standard 90.1-1999							
2010				0.7	0.9	1.5	2.5
2020				1.5	1.9	3.2	5.4
2030				1.6	2.0	3.4	5.7
2004-2030				30.5	37.7	65.5	109.4
EMISSIONS REDUCTIONS (2004-2030)				**Million Metric Tons**			
Relative to EPCA 1992							
Carbon Equivalent			1.6	2.0	2.1	2.6	3.2
NOx			0.01	0.02	0.02	0.02	0.03
Relative to Standard 90.1-1999							
Carbon Equivalent				0.4	0.6	1.0	1.6
NOx				0.00	0.00	0.01	0.01
NET PRESENT VALUE (NPV) @ Discount Rate of		7.0%		**Million 1998 Dollars**			
Relative to EPCA 1992			$7.8	-$57.1	-$78.7	-$234.7	-$788.1
Relative to Standard 90.1-1999				-$65.0	-$86.5	-$242.5	-$795.9
Adjust AEO Fuel Prices:	Multiplier:	1.05	Adder ($/kWh):	$0.000			
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Product:	Central, Air Source HP, >=65, <135 kBtu/h				Supplemental Results		
Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	ARI Curve Endpoint	90.1R Tier2	Upgrade Group	MaxAvail
EER	8.9	8.9	10.1	10.5	10.6	11.0	11.7
		Key Results: Per Unit Basis					
Input Capacity (kW)	10.112	10.112	8.911	8.571	8.491	8.182	7.692
National Ave FLEOH	1,537.1	1,537.1	1,537.1	1,537.1	1,537.1	1,537.1	1,537.1
Life-Cycle Costs: 1) wgted market segments , 2) w/nat. ave. energy price					2010 Ave. Energy Price=		$0.067
1) Wgted LCC	$14,573	$14,573	$14,533	$14,875	$14,989	$15,809	$18,721
2) LCC/ave energy price	$14,399	$14,399	$14,379	$14,727	$14,842	$15,668	$18,588
Measures of Investment Performance For Efficiency Levels Exceeding EPCA 1992 (for Year 2010)							
Based on National Average Values for Unit Consumption and Energy Price--Relative to EPCA 1992							
	Payback Period (yrs)		8.8	11.0	11.6	15.3	25.8
	Cost of Saved Energy ($/kWh)		$0.064	$0.081	$0.085	$0.113	$0.189
	NPV (= LCC Savings) ($)		$19	-$329	-$444	-$1,270	-$4,190
	Internal Rate of Return		7.3%	3.9%	3.1%	-0.5%	-6.3%
Based on National Average Values for Unit Consumption and Energy Price--Relative to Standard 90.1-1999							
	Payback Period (yrs)		NA	18.9	19.7	26.1	42.6
	Cost of Saved Energy ($/kWh)		NA	$0.139	$0.144	$0.192	$0.312
	NPV (= LCC Savings) ($)		$0	-$348	-$463	-$1,289	-$4,209
	Internal Rate of Return		NA	-3.0%	-3.4%	-6.5%	NA
	Break-even cost multiplier			0.473	0.455	0.342	0.210
		Aggregate Measures					
National Energy Consumption			**Trillion Btu (Primary)**				
2010	20.8	20.8	18.3	17.6	17.5	16.8	15.8
2020	45.0	45.0	39.6	38.1	37.8	36.4	34.2
2030	47.1	47.1	41.5	39.9	39.5	38.1	35.8
Cumulative, 2004-2030	908.0	908.0	800.1	769.6	762.4	734.7	690.7
Emissions			**Million Metric Tons**				
Carbon (MMtons)	13.9	13.9	12.3	11.9	11.8	11.4	10.7
NOX (MMtons)	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Discounted LCC for Nation			**Millions of 1998 $**				
from Market Segments	3,707.1	3,707.1	3,699.3	3,764.2	3,785.8	3,941.7	4,495.2
National NPV							
Relative to EPCA 1992			7.8	-57.1	-78.7	-234.7	-788.1
Relative to 90.1-1999				-65.0	-86.5	-242.5	-795.9

Quick Calc with National Averages (2010) (Note: Energy price fixed at 2010 value)

	EPCA 1992	Market Baseline	Standard 90.1-1999	ARI Curve Endpoint	90.1R Tier2	Upgrade Group	MaxAvail
Energy Price ($/kWh),	$0.067	$0.067	$0.067	$0.067	$0.067	$0.067	$0.067
Ann. energy use (kWh)	15,544	15,544	13,697	13,175	13,051	12,576	11,824
Standby Losses (kWh)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy cost, $/yr	$1,039	$1,039	$915	$881	$872	$840	$790
PV (energy cost)	$9,461	$9,461	$8,337	$8,020	$7,944	$7,655	$7,197
Equipment Cost	$5,113	$5,113	$6,197	$6,857	$7,046	$8,155	$11,525
Unit LCC	$14,574	$14,574	$14,534	$14,876	$14,990	$15,810	$18,722
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Product: **Central, Water Cooled AC, <65 kBtu/h**

Output Capacity (Btu/hr)	60,000	Estimated Shipments in 1999	700
Lifetime (years)	19	Projected Shipments, 2004-2030	22,466
Equip. Price Markup	25%		

Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	EFFLabel_3	90.1R Tier 2	Upgrade Group	MaxAvail
EER	9.3	9.3	12.1	12.5	13.1	14.0	12.5
Standby Loss (NA)	0	0	0	0	0	0	0
Equip. Price (w/o markup)	$2,710	$2,710	$3,574	$3,753	$4,081	$4,799	$3,753
Equip. Price (w/ markup)	$3,387	$3,387	$4,467	$4,691	$5,101	$5,998	$4,691
Year of Standard	NA	NA	2004	2004	2004	2004	2004

LIFE CYCLE COST (LCC) SAVINGS, for 2010	**1998 Dollars per Unit**				
Savings relative to EPCA 1992					
Weighted Average LCC Savings	$594	$548	$385	-$183	$548
Max LCC Savings	$2,908	$3,109	$3,286	$3,176	$3,109
Min LCC Savings	-$692	-$874	-$1,227	-$2,048	-$874
Percentage of units with LCC savings > 0	81.0%	71.1%	61.1%	39.1%	71.1%

NATIONAL ENERGY SAVINGS	**Trillion Btu (Primary)**				
Relative to EPCA 1992					
2010	0.1	0.1	0.2	0.2	0.1
2020	0.3	0.4	0.4	0.5	0.4
2030	0.4	0.4	0.5	0.5	0.4
2004-2030	6.6	7.3	8.2	9.5	7.3
Relative to Standard 90.1-1999					
2010		0.0	0.0	0.1	0.0
2020		0.0	0.1	0.1	0.0
2030		0.0	0.1	0.2	0.0
2004-2030		0.7	1.7	3.0	0.7

EMISSIONS REDUCTIONS (2004-2030)	**Million Metric Tons**				
Relative to EPCA 1992					
Carbon Equivalent	0.1	0.1	0.1	0.1	0.1
NOx	0.00	0.00	0.00	0.00	0.00
Relative to Standard 90.1-1999					
Carbon Equivalent		0.0	0.0	0.0	0.0
NOx		0.00	0.00	0.00	0.00

NET PRESENT VALUE (NPV) @ Discount Rate of 7.0%	**Million 1998 Dollars**				
Relative to EPCA 1992	$4.7	$4.3	$3.0	-$1.4	$4.3
Relative to Standard 90.1-1999		-$0.4	-$1.6	-$6.1	-$0.4

Adjust AEO Fuel Prices:	Multiplier:	1.05	Adder ($/kWh):	$0.000
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Product:	Central, Water Cooled AC, <65 kBtu/h				*Supplemental Results*		
Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	EFFLabel_3	90.1R Tier 2	Upgrade Group	MaxAvail
EER	9.3	9.3	12.1	12.5	13.1	14.0	12.5
			Key Results: Per Unit Basis				
Input Capacity (kW)	6.452	6.452	4.959	4.800	4.580	4.286	4.800
National Ave FLEOH	1,622.5	1,622.5	1,622.5	1,622.5	1,622.5	1,622.5	1,622.5
Life-Cycle Costs: 1) wgted market segments , 2) w/nat. ave. energy price					2010 Ave. Energy Price=		$0.067
1) Wgted LCC	$10,621	$10,621	$10,027	$10,073	$10,236	$10,804	$10,073
2) LCC/ave energy price	$10,477	$10,477	$9,916	$9,966	$10,134	$10,708	$9,966
Measures of Investment Performance For Efficiency Levels Exceeding EPCA 1992 (for Year 2010)							
Based on National Average Values for Unit Consumption and Energy Price--Relative to EPCA 1992							
	Payback Period (yrs)		6.7	7.3	8.4	11.1	7.3
	Cost of Saved Energy ($/kWh)		$0.043	$0.047	$0.055	$0.072	$0.047
	NPV (= LCC Savings) ($)		$560	$511	$343	-$231	$511
	Internal Rate of Return		13.4%	11.9%	9.6%	5.8%	11.9%
Based on National Average Values for Unit Consumption and Energy Price--Relative to Standard 90.1-1999							
	Payback Period (yrs)		NA	13.0	15.4	21.0	13.0
	Cost of Saved Energy ($/kWh)		NA	$0.084	$0.100	$0.136	$0.084
	NPV (= LCC Savings) ($)		$0	-$49	-$217	-$791	-$49
	Internal Rate of Return		NA	3.9%	1.9%	-1.2%	3.9%
	Break-even cost multiplier			0.780	0.657	0.483	0.780
			Aggregate Measures				
National Energy Consumption			**Trillion Btu (Primary)**				
2010	0.6	0.6	0.4	0.4	0.4	0.4	0.4
2020	1.4	1.4	1.1	1.0	1.0	0.9	1.0
2030	1.6	1.6	1.2	1.2	1.2	1.1	1.2
Cumulative, 2004-2030	28.4	28.4	21.9	21.2	20.2	18.9	21.2
Emissions				**Million Metric Tons**			
Carbon (MMtons)	0.4	0.4	0.3	0.3	0.3	0.3	0.3
NOX (MMtons)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Discounted LCC for Nation				**Millions of 1998 $**			
from Market Segments	111.2	111.2	106.5	106.9	108.2	112.6	106.9
National NPV							
Relative to EPCA 1992			4.7	4.3	3.0	-1.4	4.3
Relative to 90.1-1999				-0.4	-1.6	-6.1	-0.4

Quick Calc with National Averages (2010) (Note: Energy price fixed at 2010 value)

Energy Price ($/kWh),	$0.067	$0.067	$0.067	$0.067	$0.067	$0.067	$0.067
Ann. energy use (kWh)	10,468	10,468	8,045	7,788	7,431	6,954	7,788
Standby Losses (kWh)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy cost, $/yr	$700	$700	$538	$520	$497	$465	$520
PV (energy cost)	$7,230	$7,230	$5,557	$5,379	$5,133	$4,803	$5,379
Equipment Cost	$3,387	$3,387	$4,467	$4,691	$5,101	$5,998	$4,691
Unit LCC	$10,617	$10,617	$10,025	$10,070	$10,234	$10,801	$10,070
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Product: **Central, Water Source HP, <17kBtu/h**

Output Capacity (Btu/hr)	12,000	Estimated Shipments in 1999	41,000
Lifetime (years)	19	Projected Shipments, 2004-2030	1,315,837
Equip. Price Markup	25%		

Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	90.1R Tier 2	EFFLabel_4	Upgrade Group	MaxAvail
EER	9.3	9.3	11.2	12.5	13.1	14.0	15.8
Standby Loss (NA)	0	0	0	0	0	0	0
Equip. Price (w/o markup)	$614	$614	$712	$844	$947	$1,166	
Equip. Price (w/ markup)	$768	$768	$890	$1,054	$1,183	$1,457	NA
Year of Standard	NA	NA	2004	2004	2004	2004	2004
LIFE CYCLE COST (LCC) SAVINGS, for 2010			**1998 Dollars per Unit**				
Savings relative to EPCA 1992							
Weighted Average LCC Savings			$124	$84	$4	-$204	NA
Max LCC Savings			$463	$596	$584	$468	NA
Min LCC Savings			-$65	-$201	-$318	-$577	NA
Percentage of units with LCC savings > 0			92.2%	67.6%	47.1%	13.2%	0.0%
NATIONAL ENERGY SAVINGS			**Trillion Btu (Primary)**				
Relative to EPCA 1992							
2010			1.1	1.7	2.0	2.3	2.8
2020			2.8	4.2	4.8	5.5	6.7
2030			3.2	4.9	5.5	6.4	7.8
2004-2030			56.5	85.3	96.6	111.8	137.0
Relative to Standard 90.1-1999							
2010				0.6	0.8	1.1	1.6
2020				1.4	2.0	2.7	4.0
2030				1.6	2.3	3.2	4.6
2004-2030				28.8	40.1	55.3	80.5
EMISSIONS REDUCTIONS (2004-2030)			**Million Metric Tons**				
Relative to EPCA 1992							
Carbon Equivalent			0.8	1.3	1.4	1.6	2.0
NOx			0.01	0.01	0.01	0.01	0.02
Relative to Standard 90.1-1999							
Carbon Equivalent				0.4	0.6	0.8	1.2
NOx				0.00	0.01	0.01	0.01
NET PRESENT VALUE (NPV) @ Discount Rate of		7.0%	**Million 1998 Dollars**				
Relative to EPCA 1992			$56.7	$38.5	$2.0	-$93.2	NA
Relative to Standard 90.1-1999				-$18.3	-$54.7	-$149.9	NA

Adjust AEO Fuel Prices:	Multiplier:	1.05	Adder ($/kWh):	$0.000
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Product:	Central, Water Source HP, <17kBtu/h				*Supplemental Results*		
Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	90.1R Tier 2	EFFLabel_4	Upgrade Group	MaxAvail
EER	9.3	9.3	11.2	12.5	13.1	14.0	15.8
		Key Results: Per Unit Basis					
Input Capacity (kW)	1.290	1.290	1.071	0.960	0.916	0.857	0.759
National Ave FLEOH	1,622.5	1,622.5	1,622.5	1,622.5	1,622.5	1,622.5	1,622.5
Life-Cycle Costs: 1) wgted market segments , 2) w/nat. ave. energy price					2010 Ave. Energy Price=		$0.067
1) Wgted LCC	$2,214	$2,214	$2,091	$2,131	$2,210	$2,418	NA
2) LCC/ave energy price	$2,186	$2,186	$2,067	$2,109	$2,190	$2,399	NA
Measures of Investment Performance For Efficiency Levels Exceeding EPCA 1992 (for Year 2010)							
Based on National Average Values for Unit Consumption and Energy Price--Relative to EPCA 1992							
	Payback Period (yrs)		5.1	8.0	10.2	14.7	NA
	Cost of Saved Energy ($/kWh)		$0.033	$0.052	$0.066	$0.095	NA
	NPV (= LCC Savings) ($)		$119	$76	-$4	-$213	NA
	Internal Rate of Return		18.4%	10.4%	6.9%	2.5%	NA
Based on National Average Values for Unit Consumption and Energy Price--Relative to Standard 90.1-1999							
	Payback Period (yrs)		NA	13.6	17.4	24.4	NA
	Cost of Saved Energy ($/kWh)		NA	$0.088	$0.113	$0.158	NA
	NPV (= LCC Savings) ($)		$0	-$42	-$123	-$332	NA
	Internal Rate of Return		NA	3.3%	0.7%	-2.6%	NA
	Break-even cost multiplier			0.743	0.581	0.415	NA
		Aggregate Measures					
National Energy Consumption			**Trillion Btu (Primary)**				
2010	6.8	6.8	5.6	5.0	4.8	4.5	4.0
2020	16.4	16.4	13.6	12.2	11.6	10.9	9.7
2030	19.0	19.0	15.8	14.1	13.5	12.6	11.2
Cumulative, 2004-2030	333.1	333.1	276.6	247.8	236.5	221.3	196.1
Emissions				**Million Metric Tons**			
Carbon (MMtons)	5.1	5.1	4.3	3.8	3.7	3.4	3.1
NOX (MMtons)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Discounted LCC for Nation				**Millions of 1998 $**			
from Market Segments	1,357.6	1,357.6	1,300.9	1,319.2	1,355.6	1,450.8	NA
National NPV							
Relative to EPCA 1992			56.7	38.5	2.0	-93.2	NA
Relative to 90.1-1999				-18.3	-54.7	-149.9	NA

Quick Calc with National Averages (2010) ***(Note: Energy price fixed at 2010 value)***

Energy Price ($/kWh),	$0.067	$0.067	$0.067	$0.067	$0.067	$0.067	$0.067
Ann. energy use (kWh)	2,094	2,094	1,738	1,558	1,486	1,391	1,232
Standby Losses (kWh)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy cost, $/yr	$140	$140	$116	$104	$99	$93	$82
PV (energy cost)	$1,446	$1,446	$1,201	$1,076	$1,027	$961	$851
Equipment Cost	$768	$768	$890	$1,054	$1,183	$1,457	NA
Unit LCC	$2,214	$2,214	$2,090	$2,130	$2,210	$2,418	NA
Report created:	3/31/00 10:48 AM						

Product: **Central, Water Source HP, >17, <65 kBtu/h**

Output Capacity (Btu/hr)	36,000	Estimated Shipments in 1999	86,000
Lifetime (years)	19	Projected Shipments, 2004-2030	2,760,047
Equip. Price Markup	25%		

Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	90.1R Tier 2	EFFLabel_4	Upgrade Group	MaxAvail
EER	9.3	9.3	12.0	12.5	13.1	14.0	15.2
Standby Loss (NA)	0	0	0	0	0	0	0
Equip. Price (w/o markup)	$861	$861	$1,094	$1,183	$1,327	$1,635	
Equip. Price (w/ markup)	$1,076	$1,076	$1,368	$1,479	$1,659	$2,043	NA
Year of Standard	NA	NA	2004	2004	2004	2004	2004
LIFE CYCLE COST (LCC) SAVINGS, for 2010				**1998 Dollars per Unit**			
Savings relative to EPCA 1992							
Weighted Average LCC Savings			$685	$709	$676	$490	NA
Max LCC Savings			$2,036	$2,246	$2,417	$2,505	NA
Min LCC Savings			-$65	-$144	-$291	-$629	NA
Percentage of units with LCC savings > 0			99.9%	99.8%	95.2%	80.1%	0.0%
NATIONAL ENERGY SAVINGS				**Trillion Btu (Primary)**			
Relative to EPCA 1992							
2010			9.6	10.9	12.3	14.3	16.5
2020			23.2	26.4	29.9	34.7	40.1
2030			26.9	30.6	34.7	40.2	46.4
2004-2030			471.6	536.6	608.0	703.7	813.6
Relative to Standard 90.1-1999							
2010				1.3	2.8	4.7	6.9
2020				3.2	6.7	11.4	16.8
2030				3.7	7.8	13.2	19.5
2004-2030				65.0	136.4	232.1	342.0
EMISSIONS REDUCTIONS (2004-2030)				**Million Metric Tons**			
Relative to EPCA 1992							
Carbon Equivalent			6.9	7.9	8.9	10.3	12.0
NOx			0.06	0.07	0.08	0.09	0.11
Relative to Standard 90.1-1999							
Carbon Equivalent				1.0	2.0	3.4	5.0
NOx				0.01	0.02	0.03	0.05
NET PRESENT VALUE (NPV) @ Discount Rate of		7.0%		**Million 1998 Dollars**			
Relative to EPCA 1992			$659.8	$682.8	$651.4	$472.9	NA
Relative to Standard 90.1-1999				$23.0	-$8.4	-$186.9	NA

Adjust AEO Fuel Prices:	Multiplier:	1.05	Adder ($/kWh):	$0.000
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Product:	Central, Water Source HP, >17, <65 kBtu/h				*Supplemental Results*		
Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	90.1R Tier 2	EFFLabel_4	Upgrade Group	MaxAvail
EER	9.3	9.3	12.0	12.5	13.1	14.0	15.2
Key Results: Per Unit Basis							
Input Capacity (kW)	3.871	3.871	3.000	2.880	2.748	2.571	2.368
National Ave FLEOH	1,622.5	1,622.5	1,622.5	1,622.5	1,622.5	1,622.5	1,622.5
Life-Cycle Costs: 1) wgted market segments , 2) w/nat. ave. energy price					2010 Ave. Energy Price=		$0.067
1) Wgted LCC	$5,417	$5,417	$4,732	$4,708	$4,741	$4,926	NA
2) LCC/ave energy price	$5,330	$5,330	$4,665	$4,643	$4,679	$4,869	NA
Measures of Investment Performance For Efficiency Levels Exceeding EPCA 1992 (for Year 2010)							
Based on National Average Values for Unit Consumption and Energy Price--Relative to EPCA 1992							
Payback Period (yrs)			3.1	3.7	4.8	6.9	NA
Cost of Saved Energy ($/kWh)			$0.020	$0.024	$0.031	$0.044	NA
NPV (= LCC Savings) ($)			$666	$687	$651	$461	NA
Internal Rate of Return			31.8%	26.0%	19.9%	12.9%	NA
Based on National Average Values for Unit Consumption and Energy Price--Relative to Standard 90.1-1999							
Payback Period (yrs)			NA	8.5	10.7	14.5	NA
Cost of Saved Energy ($/kWh)			NA	$0.055	$0.069	$0.094	NA
NPV (= LCC Savings) ($)			$0	$21	-$15	-$204	NA
Internal Rate of Return			NA	9.5%	6.3%	2.6%	NA
Break-even cost multiplier				1.191	0.950	0.697	NA
Aggregate Measures							
National Energy Consumption			**Trillion Btu (Primary)**				
2010	42.5	42.5	33.0	31.6	30.2	28.2	26.0
2020	103.2	103.2	80.0	76.8	73.3	68.6	63.2
2030	119.6	119.6	92.7	89.0	84.9	79.4	73.2
Cumulative, 2004-2030	2,096.0	2,096.0	1,624.4	1,559.4	1,488.0	1,392.3	1,282.4
Emissions			**Million Metric Tons**				
Carbon (MMtons)	32.0	32.0	25.1	24.1	23.0	21.6	20.0
NOX (MMtons)	0.3	0.3	0.2	0.2	0.2	0.2	0.2
Discounted LCC for Nation			**Millions of 1998 $**				
from Market Segments	6,975.8	6,975.8	6,316.0	6,293.0	6,324.3	6,502.9	NA
National NPV							
Relative to EPCA 1992			659.8	682.8	651.4	472.9	NA
Relative to 90.1-1999				23.0	-8.4	-186.9	NA

Quick Calc with National Averages (2010) ***(Note: Energy price fixed at 2010 value)***

Energy Price ($/kWh),	$0.067	$0.067	$0.067	$0.067	$0.067	$0.067	$0.067
Ann. energy use (kWh)	6,281	6,281	4,867	4,673	4,459	4,172	3,843
Standby Losses (kWh)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy cost, $/yr	$420	$420	$325	$312	$298	$279	$257
PV (energy cost)	$4,338	$4,338	$3,362	$3,228	$3,080	$2,882	$2,654
Equipment Cost	$1,076	$1,076	$1,368	$1,479	$1,659	$2,043	NA
Unit LCC	$5,415	$5,415	$4,730	$4,706	$4,739	$4,925	NA
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Product:	Central, Water Cooled AC, >=65, <135 kBtu/h						
Output Capacity (Btu/hr)	90,000			Estimated Shipments in 1999			800
Lifetime (years)	19			Projected Shipments, 2004-2030			25,675
Equip. Price Markup	25%						

Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	EFFLabel_3	90.1R Tier 2	Upgrade Group	0
EER	10.5	10.5	11.5	12.0	12.4	14.0	0.0
Standby Loss (NA)	0	0	0	0	0	0	0
Equip. Price (w/o markup)	$2,908	$2,908	$3,348	$3,563	$3,761	$4,715	
Equip. Price (w/ markup)	$3,636	$3,636	$4,185	$4,454	$4,701	$5,893	NA
Year of Standard	NA	NA	2004	2004	2004	2004	2004

LIFE CYCLE COST (LCC) SAVINGS, for 2010			**1998 Dollars per Unit**			
Savings relative to EPCA 1992						
Weighted Average LCC Savings	$242	$318	$328	$15	NA	
Max LCC Savings	$1,442	$2,045	$2,444	$3,468	NA	
Min LCC Savings	-$379	-$573	-$765	-$1,768	NA	
Percentage of units with LCC savings > 0	74.5%	70.1%	63.7%	44.2%	0.0%	

NATIONAL ENERGY SAVINGS			**Trillion Btu (Primary)**		
Relative to EPCA 1992					
2010	0.1	0.1	0.1	0.2	NA
2020	0.2	0.3	0.3	0.5	NA
2030	0.2	0.3	0.4	0.6	NA
2004-2030	3.6	5.1	6.3	10.2	NA
Relative to Standard 90.1-1999					
2010		0.0	0.1	0.1	NA
2020		0.1	0.1	0.3	NA
2030		0.1	0.2	0.4	NA
2004-2030		1.6	2.7	6.7	NA

EMISSIONS REDUCTIONS (2004-2030)			**Million Metric Tons**		
Relative to EPCA 1992					
Carbon Equivalent	0.1	0.1	0.1	0.2	NA
NOx	0.00	0.00	0.00	0.00	NA
Relative to Standard 90.1-1999					
Carbon Equivalent		0.0	0.0	0.1	NA
NOx		0.00	0.00	0.00	NA

NET PRESENT VALUE (NPV) @ Discount Rate of 7.0%			**Million 1998 Dollars**		
Relative to EPCA 1992	$2.2	$2.9	$2.9	$0.2	NA
Relative to Standard 90.1-1999		$0.7	$0.8	-$2.0	NA

Adjust AEO Fuel Prices: Multiplier: 1.05 Adder ($/kWh): $0.000

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Product:	Central, Water Cooled AC, >=65, <135 kBtu/h				*Supplemental Results*		
Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	EFFLabel_3	90.1R Tier 2	Upgrade Group	0
EER	10.5	10.5	11.5	12.0	12.4	14.0	0.0
			Key Results: Per Unit Basis				
Input Capacity (kW)	8.571	8.571	7.826	7.500	7.258	6.429	NA
National Ave FLEOH	1,537.1	1,537.1	1,537.1	1,537.1	1,537.1	1,537.1	1,537.1
Life-Cycle Costs: 1) wgted market segments , 2) w/nat. ave. energy price					2010 Ave. Energy Price=		$0.067
1) Wgted LCC	$12,728	$12,728	$12,486	$12,409	$12,400	$12,712	NA
2) LCC/ave energy price	$12,559	$12,559	$12,332	$12,261	$12,257	$12,586	NA
Measures of Investment Performance For Efficiency Levels Exceeding EPCA 1992 (for Year 2010)							
Based on National Average Values for Unit Consumption and Energy Price--Relative to EPCA 1992							
	Payback Period (yrs)		7.2	7.4	7.9	10.3	NA
	Cost of Saved Energy ($/kWh)		$0.046	$0.048	$0.051	$0.066	NA
	NPV (= LCC Savings) ($)		$227	$297	$302	-$27	NA
	Internal Rate of Return		12.1%	11.6%	10.6%	6.8%	NA
Based on National Average Values for Unit Consumption and Energy Price--Relative to Standard 90.1-1999							
	Payback Period (yrs)		NA	8.0	8.8	11.9	NA
	Cost of Saved Energy ($/kWh)		NA	$0.052	$0.057	$0.077	NA
	NPV (= LCC Savings) ($)		$0	$70	$75	-$254	NA
	Internal Rate of Return		NA	10.3%	8.9%	4.9%	NA
	Break-even cost multiplier			1.262	1.145	0.851	NA
			Aggregate Measures				
National Energy Consumption			**Trillion Btu (Primary)**				
2010	0.8	0.8	0.8	0.7	0.7	0.6	NA
2020	2.0	2.0	1.8	1.8	1.7	1.5	NA
2030	2.3	2.3	2.1	2.0	2.0	1.8	NA
Cumulative, 2004-2030	40.9	40.9	37.3	35.8	34.6	30.7	NA
Emissions				**Million Metric Tons**			
Carbon (MMtons)	0.6	0.6	0.6	0.5	0.5	0.5	NA
NOX (MMtons)	0.0	0.0	0.0	0.0	0.0	0.0	NA
Discounted LCC for Nation				**Millions of 1998 $**			
from Market Segments	152.3	152.3	150.2	149.5	149.4	152.2	NA
National NPV							
Relative to EPCA 1992			2.2	2.9	2.9	0.2	NA
Relative to 90.1-1999				0.7	0.8	-2.0	NA

Quick Calc with National Averages (2010) ***(Note: Energy price fixed at 2010 value)***

Energy Price ($/kWh),	$0.067	$0.067	$0.067	$0.067	$0.067	$0.067	$0.067
Ann. energy use (kWh)	13,175	13,175	12,029	11,528	11,156	9,881	NA
Standby Losses (kWh)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy cost, $/yr	$881	$881	$804	$770	$746	$660	NA
PV (energy cost)	$9,101	$9,101	$8,309	$7,963	$7,706	$6,825	NA
Equipment Cost	$3,636	$3,636	$4,185	$4,454	$4,701	$5,893	NA
Unit LCC	$12,736	$12,736	$12,494	$12,417	$12,407	$12,719	NA
Report created:	3/31/00 10:50 AM						

Product:	**Central, Water Source HP, >=65, <135 kBtu/h**						
Output Capacity (Btu/hr)	90,000			Estimated Shipments in 1999			5,000
Lifetime (years)	19			Projected Shipments, 2004-2030			160,468
Equip. Price Markup	25%						

Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	90.1R Tier 2	EFFLabel_4	Upgrade Group	MaxAvail
EER	10.5	10.5	12.0	12.5	13.0	14.0	0.0
Standby Loss (NA)	0	0	0	0	0	0	0
Equip. Price (w/o markup)	$2,768	$2,768	$3,239	$3,502	$3,848	$4,839	
Equip. Price (w/ markup)	$3,461	$3,461	$4,049	$4,378	$4,810	$6,049	NA
Year of Standard	NA	NA	2004	2004	2004	2004	2004
LIFE CYCLE COST (LCC) SAVINGS, for 2010				**1998 Dollars per Unit**			
Savings relative to EPCA 1992							
Weighted Average LCC Savings			$548	$538	$399	-$316	NA
Max LCC Savings			$2,274	$2,747	$3,054	$3,137	NA
Min LCC Savings			-$344	-$604	-$973	-$2,099	NA
Percentage of units with LCC savings > 0			90.1%	78.3%	63.7%	37.7%	0.0%
NATIONAL ENERGY SAVINGS				**Trillion Btu (Primary)**			
Relative to EPCA 1992							
2010			0.6	0.8	1.0	1.3	NA
2020			1.6	2.0	2.4	3.1	NA
2030			1.8	2.3	2.8	3.6	NA
2004-2030			32.0	40.9	49.2	63.9	NA
Relative to Standard 90.1-1999							
2010				0.2	0.3	0.6	NA
2020				0.4	0.8	1.6	NA
2030				0.5	1.0	1.8	NA
2004-2030				8.9	17.2	32.0	NA
EMISSIONS REDUCTIONS (2004-2030)				**Million Metric Tons**			
Relative to EPCA 1992							
Carbon Equivalent			0.5	0.6	0.7	0.9	NA
NOx			0.00	0.01	0.01	0.01	NA
Relative to Standard 90.1-1999							
Carbon Equivalent				0.1	0.3	0.5	NA
NOx				0.00	0.00	0.00	NA
NET PRESENT VALUE (NPV) @ Discount Rate of		7.0%		**Million 1998 Dollars**			
Relative to EPCA 1992			$30.7	$30.1	$22.4	-$17.5	NA
Relative to Standard 90.1-1999				-$0.6	-$8.3	-$48.2	NA
Adjust AEO Fuel Prices:	Multiplier:	1.05	Adder ($/kWh):		$0.000		
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Product:	Central, Water Source HP, >=65, <135 kBtu/h				*Supplemental Results*		
Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	90.1R Tier 2	EFFLabel_4	Upgrade Group	MaxAvail
EER	10.5	10.5	12.0	12.5	13.0	14.0	0.0
		Key Results: Per Unit Basis					
Input Capacity (kW)	8.571	8.571	7.500	7.200	6.923	6.429	NA
National Ave FLEOH	1,537.1	1,537.1	1,537.1	1,537.1	1,537.1	1,537.1	1,537.1
Life-Cycle Costs: 1) wgted market segments , 2) w/nat. ave. energy price					2010 Ave. Energy Price=		$0.067
1) Wgted LCC	$12,553	$12,553	$12,004	$12,015	$12,154	$12,868	NA
2) LCC/ave energy price	$12,384	$12,384	$11,857	$11,873	$12,017	$12,742	NA
Measures of Investment Performance For Efficiency Levels Exceeding EPCA 1992 (for Year 2010)							
Based on National Average Values for Unit Consumption and Energy Price--Relative to EPCA 1992							
Payback Period (yrs)			5.3	6.5	8.0	11.8	NA
Cost of Saved Energy ($/kWh)			$0.035	$0.042	$0.052	$0.076	NA
NPV (= LCC Savings) ($)			$527	$511	$366	-$358	NA
Internal Rate of Return			17.5%	13.8%	10.5%	5.1%	NA
Based on National Average Values for Unit Consumption and Energy Price--Relative to Standard 90.1-1999							
Payback Period (yrs)			NA	10.7	12.8	18.2	NA
Cost of Saved Energy ($/kWh)			NA	$0.069	$0.083	$0.118	NA
NPV (= LCC Savings) ($)			$0	-$16	-$161	-$885	NA
Internal Rate of Return			NA	6.3%	4.0%	0.2%	NA
Break-even cost multiplier				0.950	0.789	0.558	NA
		Aggregate Measures					
National Energy Consumption			**Trillion Btu (Primary)**				
2010	5.2	5.2	4.5	4.4	4.2	3.9	NA
2020	12.6	12.6	11.0	10.6	10.2	9.4	NA
2030	14.6	14.6	12.8	12.3	11.8	10.9	NA
Cumulative, 2004-2030	255.6	255.6	223.7	214.7	206.5	191.7	NA
Emissions			**Million Metric Tons**				
Carbon (MMtons)	3.9	3.9	3.4	3.3	3.2	3.0	NA
NOX (MMtons)	0.0	0.0	0.0	0.0	0.0	0.0	NA
Discounted LCC for Nation			**Millions of 1998 $**				
from Market Segments	939.1	939.1	908.4	909.0	916.7	956.7	NA
National NPV							
Relative to EPCA 1992			30.7	30.1	22.4	-17.5	NA
Relative to 90.1-1999				-0.6	-8.3	-48.2	NA

Quick Calc with National Averages (2010) ***(Note: Energy price fixed at 2010 value)***

Energy Price ($/kWh),	$0.067	$0.067	$0.067	$0.067	$0.067	$0.067	$0.067
Ann. energy use (kWh)	13,175	13,175	11,528	11,067	10,641	9,881	NA
Standby Losses (kWh)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy cost, $/yr	$881	$881	$770	$740	$711	$660	NA
PV (energy cost)	$9,101	$9,101	$7,963	$7,645	$7,350	$6,825	NA
Equipment Cost	$3,461	$3,461	$4,049	$4,378	$4,810	$6,049	NA
Unit LCC	$12,561	$12,561	$12,012	$12,022	$12,161	$12,875	NA
Report created:	3/31/00 10:50 AM						

Product: **Central, Air Source AC, >=135, <240 kBtu/h**

Output Capacity (Btu/hr)	180,000	Estimated Shipments in 1999	65,000
Lifetime (years)	15	Projected Shipments, 2004-2030	2,086,082
Equip. Price Markup	25%		

Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	90.1R Tier 2	Tier 1 Analysis	Upgrade Group	MaxAvail
EER	8.5	8.5	9.7	10.2	10.4	10.8	11.5
Standby Loss (NA)	0	0	0	0	0	0	0
Equip. Price (w/o markup)	$6,798	$6,798	$7,614	$7,886	$8,089		
Equip. Price (w/ markup)	$8,497	$8,497	$9,517	$9,857	$10,112	NA	NA
Year of Standard	NA	NA	2004	2004	2004	2004	2004
LIFE CYCLE COST (LCC) SAVINGS, for 2010			**1998 Dollars per Unit**				
Savings relative to EPCA 1992							
Weighted Average LCC Savings			$1,431	$1,942	$2,005	NA	NA
Max LCC Savings			$5,163	$6,970	$7,516	NA	NA
Min LCC Savings			-$491	-$648	-$834	NA	NA
Percentage of units with LCC savings > 0			97.5%	97.5%	95.4%	0.0%	0.0%
NATIONAL ENERGY SAVINGS			**Trillion Btu (Primary)**				
Relative to EPCA 1992							
2010			20.6	27.8	30.4	35.5	43.5
2020			44.6	60.0	65.8	76.7	94.0
2030			46.6	62.8	68.9	80.3	98.4
2004-2030			899.4	1,211.7	1,328.2	1,548.3	1,896.6
Relative to Standard 90.1-1999							
2010				7.2	9.8	14.9	22.8
2020				15.5	21.2	32.2	49.4
2030				16.2	22.2	33.7	51.7
2004-2030				312.3	428.8	648.9	997.2
EMISSIONS REDUCTIONS (2004-2030)			**Million Metric Tons**				
Relative to EPCA 1992							
Carbon Equivalent			13.2	17.8	19.5	22.8	27.9
NOx			0.12	0.16	0.18	0.20	0.25
Relative to Standard 90.1-1999							
Carbon Equivalent				4.6	6.3	9.5	14.7
NOx				0.04	0.06	0.09	0.13
NET PRESENT VALUE (NPV) @ Discount Rate of		7.0%	**Million 1998 Dollars**				
Relative to EPCA 1992			$1,042.2	$1,414.4	$1,460.1	NA	NA
Relative to Standard 90.1-1999				$372.2	$417.9	NA	NA

Adjust AEO Fuel Prices:	Multiplier:	1.05	Adder ($/kWh):	$0.000
Report created:	3/31/00 10:51 AM			

Product:	**Central, Air Source AC, >=135, <240 kBtu/h**				***Supplemental Results***		
Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	90.1R Tier 2	ASHRAE Tier 1 Analysis	Upgrade Group	MaxAvail
EER	8.5	8.5	9.7	10.2	10.4	10.8	11.5
		Key Results: Per Unit Basis					
Input Capacity (kW)	21.176	21.176	18.557	17.647	17.308	16.667	15.652
National Ave FLEOH	1,537.1	1,537.1	1,537.1	1,537.1	1,537.1	1,537.1	1,537.1
Life-Cycle Costs: 1) wgted market segments , 2) w/nat. ave. energy price					2010 Ave. Energy Price=		$0.067
1) Wgted LCC	$28,308	$28,308	$26,877	$26,366	$26,303	NA	NA
2) LCC/ave energy price	$27,942	$27,942	$26,556	$26,061	$26,004	NA	NA
Measures of Investment Performance For Efficiency Levels Exceeding EPCA 1992 (for Year 2010)							
Based on National Average Values for Unit Consumption and Energy Price--Relative to EPCA 1992							
Payback Period (yrs)			3.8	3.7	4.1	NA	NA
Cost of Saved Energy ($/kWh)			$0.028	$0.028	$0.030	NA	NA
NPV (= LCC Savings) ($)			$1,386	$1,881	$1,938	NA	NA
Internal Rate of Return			25.1%	25.4%	23.2%	NA	NA
Based on National Average Values for Unit Consumption and Energy Price--Relative to Standard 90.1-1999							
Payback Period (yrs)			NA	3.6	4.6	NA	NA
Cost of Saved Energy ($/kWh)			NA	$0.027	$0.034	NA	NA
NPV (= LCC Savings) ($)			$0	$495	$552	NA	NA
Internal Rate of Return			NA	26.3%	19.8%	NA	NA
Break-even cost multiplier				2.457	1.928	NA	NA
		Aggregate Measures					
National Energy Consumption			**Trillion Btu (Primary)**				
2010	166.6	166.6	146.0	138.8	136.1	131.1	123.1
2020	360.3	360.3	315.7	300.2	294.4	283.5	266.3
2030	377.1	377.1	330.4	314.2	308.2	296.8	278.7
Cumulative, 2004-2030	7,270.2	7,270.2	6,370.8	6,058.5	5,942.0	5,722.0	5,373.7
Emissions			**Million Metric Tons**				
Carbon (MMtons)	111.5	111.5	98.3	93.7	92.0	88.7	83.6
NOX (MMtons)	1.0	1.0	0.9	0.8	0.8	0.8	0.8
Discounted LCC for Nation			**Millions of 1998 $**				
from Market Segments	27,547.8	27,547.8	26,505.6	26,133.4	26,087.7	NA	NA
National NPV							
Relative to EPCA 1992			1,042.2	1,414.4	1,460.1	NA	NA
Relative to 90.1-1999				372.2	417.9	NA	NA

Quick Calc with National Averages (2010) ***(Note: Energy price fixed at 2010 value)***

Energy Price ($/kWh),	$0.067	$0.067	$0.067	$0.067	$0.067	$0.067	$0.067
Ann. energy use (kWh)	32,550	32,550	28,523	27,125	26,604	25,618	24,059
Standby Losses (kWh)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy cost, $/yr	$2,175	$2,175	$1,906	$1,813	$1,778	$1,712	$1,608
PV (energy cost)	$19,813	$19,813	$17,362	$16,511	$16,193	$15,594	$14,645
Equipment Cost	$8,497	$8,497	$9,517	$9,857	$10,112	NA	NA
Unit LCC	$28,311	$28,311	$26,879	$26,368	$26,305	NA	NA
Report created:	3/31/00 10:51 AM						

Product: **Central, Air Source HP, >=135, <240 kBtu/h**

Output Capacity (Btu/hr)	180,000	Estimated Shipments in 1999	2,900
Lifetime (years)	15	Projected Shipments, 2004-2030	93,071
Equip. Price Markup	25%		

Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	90.1R Tier 2	ARI Curve EndPoint	Upgrade Group	MaxAvail
EER	8.5	8.5	9.3	9.8	10.4	10.8	10.5
Standby Loss (NA)	0	0	0	0	0	0	0
Equip. Price (w/o markup)	$8,357	$8,357	$9,259	$9,919	$10,713		
Equip. Price (w/ markup)	$10,446	$10,446	$11,574	$12,399	$13,392	NA	NA
Year of Standard	NA	NA	2004	2004	2004	2004	2004

LIFE CYCLE COST (LCC) SAVINGS, for 2010			**1998 Dollars per Unit**				
Savings relative to EPCA 1992							
Weighted Average LCC Savings			$576	$675	$673	NA	NA
Max LCC Savings			$3,171	$4,676	$6,185	NA	NA
Min LCC Savings			-$761	-$1,387	-$2,166	NA	NA
Percentage of units with LCC savings > 0			77.8%	70.1%	62.8%	0.0%	0.0%

NATIONAL ENERGY SAVINGS			**Trillion Btu (Primary)**				
Relative to EPCA 1992							
2010			0.6	1.0	1.4	1.6	1.4
2020			1.4	2.1	2.9	3.4	3.1
2030			1.4	2.2	3.1	3.6	3.2
2004-2030			27.9	43.0	59.3	69.1	61.8
Relative to Standard 90.1-1999							
2010				0.3	0.7	0.9	0.8
2020				0.7	1.6	2.0	1.7
2030				0.8	1.6	2.1	1.8
2004-2030				15.1	31.4	41.2	33.9

EMISSIONS REDUCTIONS (2004-2030)			**Million Metric Tons**				
Relative to EPCA 1992							
Carbon Equivalent			0.4	0.6	0.9	1.0	0.9
NOx			0.00	0.01	0.01	0.01	0.01
Relative to Standard 90.1-1999							
Carbon Equivalent				0.2	0.5	0.6	0.5
NOx				0.00	0.00	0.01	0.00

NET PRESENT VALUE (NPV) @ Discount Rate of		7.0%	**Million 1998 Dollars**				
Relative to EPCA 1992			$18.7	$22.0	$22.0	NA	NA
Relative to Standard 90.1-1999				$3.2	$3.2	NA	NA

Adjust AEO Fuel Prices:	Multiplier:	1.05	Adder ($/kWh):	$0.000
Report created:	3/31/00 10:51 AM			

Product:	**Central, Air Source HP, >=135, <240 kBtu/h**				***Supplemental Results***		
Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	90.1R Tier 2	ARI Curve EndPoint	Upgrade Group	MaxAvail
EER	8.5	8.5	9.3	9.8	10.4	10.8	10.5
			Key Results: Per Unit Basis				
Input Capacity (kW)	21.176	21.176	19.355	18.367	17.308	16.667	17.143
National Ave FLEOH	1,537.1	1,537.1	1,537.1	1,537.1	1,537.1	1,537.1	1,537.1
Life-Cycle Costs: 1) wgted market segments , 2) w/nat. ave. energy price					2010 Ave. Energy Price=		$0.067
1) Wgted LCC	$30,256	$30,256	$29,680	$29,582	$29,583	NA	NA
2) LCC/ave energy price	$29,891	$29,891	$29,346	$29,265	$29,284	NA	NA
Measures of Investment Performance For Efficiency Levels Exceeding EPCA 1992 (for Year 2010)							
Based on National Average Values for Unit Consumption and Energy Price--Relative to EPCA 1992							
Payback Period (yrs)			6.0	6.8	7.4	NA	NA
Cost of Saved Energy ($/kWh)			$0.044	$0.050	$0.054	NA	NA
NPV (= LCC Savings) ($)			$545	$626	$607	NA	NA
Internal Rate of Return			14.0%	11.8%	10.1%	NA	NA
Based on National Average Values for Unit Consumption and Energy Price--Relative to Standard 90.1-1999							
Payback Period (yrs)			NA	8.1	8.6	NA	NA
Cost of Saved Energy ($/kWh)			NA	$0.060	$0.063	NA	NA
NPV (= LCC Savings) ($)			$0	$82	$62	NA	NA
Internal Rate of Return			NA	8.5%	7.5%	NA	NA
Break-even cost multiplier				1.099	1.034	NA	NA
			Aggregate Measures				
National Energy Consumption			**Trillion Btu (Primary)**				
2010	7.4	7.4	6.8	6.4	6.1	5.8	6.0
2020	16.1	16.1	14.7	13.9	13.1	12.7	13.0
2030	16.8	16.8	15.4	14.6	13.7	13.2	13.6
Cumulative, 2004-2030	324.4	324.4	296.5	281.3	265.1	255.3	262.6
Emissions			**Million Metric Tons**				
Carbon (MMtons)	5.0	5.0	4.6	4.3	4.1	4.0	4.1
NOX (MMtons)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Discounted LCC for Nation			**Millions of 1998 $**				
from Market Segments	1,313.0	1,313.0	1,294.3	1,291.1	1,291.1	NA	NA
National NPV							
Relative to EPCA 1992			18.7	22.0	22.0	NA	NA
Relative to 90.1-1999				3.2	3.2	NA	NA

Quick Calc with National Averages (2010) (Note: Energy price fixed at 2010 value)

Energy Price ($/kWh),	$0.067	$0.067	$0.067	$0.067	$0.067	$0.067	$0.067
Ann. energy use (kWh)	32,550	32,550	29,750	28,232	26,604	25,618	26,350
Standby Losses (kWh)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy cost, $/yr	$2,175	$2,175	$1,988	$1,887	$1,778	$1,712	$1,761
PV (energy cost)	$19,813	$19,813	$18,109	$17,185	$16,193	$15,594	$16,039
Equipment Cost	$10,446	$10,446	$11,574	$12,399	$13,392	NA	NA
Unit LCC	$30,259	$30,259	$29,683	$29,584	$29,585	NA	NA
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Product:	**Central, Water Cooled AC, >=135, <240 kBtu/h**						
Output Capacity (Btu/hr)	180,000			Estimated Shipments in 1999			600
Lifetime (years)	19			Projected Shipments, 2004-2030			19,256
Equip. Price Markup	25%						
Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	0	0	0	90.1R Tier 2
EER	9.6	9.6	11.0	11.1	11.2	11.3	11.5
Standby Loss (NA)	0	0	0	0	0	0	0
Equip. Price (w/o markup)	$6,809	$6,809	$7,830	$7,830	$7,946	$7,993	$8,082
Equip. Price (w/ markup)	$8,511	$8,511	$9,788	$9,788	$9,932	$9,992	$10,102
Year of Standard	NA	NA	2004	2004	2004	2004	2004
LIFE CYCLE COST (LCC) SAVINGS, for 2010				**1998 Dollars per Unit**			
Savings relative to EPCA 1992							
Weighted Average LCC Savings			$1,255	$1,411	$1,420	$1,511	$1,694
Max LCC Savings			$5,099	$5,493	$5,735	$6,056	$6,685
Min LCC Savings			-$732	-$698	-$810	-$837	-$884
Percentage of units with LCC savings > 0			90.1%	90.5%	90.1%	90.1%	90.1%
NATIONAL ENERGY SAVINGS				**Trillion Btu (Primary)**			
Relative to EPCA 1992							
2010			0.2	0.2	0.2	0.2	0.2
2020			0.4	0.4	0.5	0.5	0.5
2030			0.5	0.5	0.5	0.6	0.6
2004-2030			8.5	9.1	9.6	10.1	11.1
Relative to Standard 90.1-1999							
2010				0.0	0.0	0.0	0.1
2020				0.0	0.1	0.1	0.1
2030				0.0	0.1	0.1	0.1
2004-2030				0.5	1.0	1.6	2.5
EMISSIONS REDUCTIONS (2004-2030)				**Million Metric Tons**			
Relative to EPCA 1992							
Carbon Equivalent			0.1	0.1	0.1	0.1	0.2
NOx			0.00	0.00	0.00	0.00	0.00
Relative to Standard 90.1-1999							
Carbon Equivalent				0.0	0.0	0.0	0.0
NOx				0.00	0.00	0.00	0.00
NET PRESENT VALUE (NPV) @ Discount Rate of		7.0%		**Million 1998 Dollars**			
Relative to EPCA 1992			$8.4	$9.5	$9.5	$10.2	$11.4
Relative to Standard 90.1-1999				$1.1	$1.1	$1.7	$3.0
Adjust AEO Fuel Prices:	Multiplier:	1.05	Adder ($/kWh):		$0.000		
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Product:	**Central, Water Cooled AC, >=135, <240 kBtu/h**				***Supplemental Results***		
Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	0	0	0	90.1R Tier 2
EER	9.6	9.6	11.0	11.1	11.2	11.3	11.5
		Key Results: Per Unit Basis					
Input Capacity (kW)	18.750	18.750	16.364	16.216	16.071	15.929	15.652
National Ave FLEOH	1,537.1	1,537.1	1,537.1	1,537.1	1,537.1	1,537.1	1,537.1
Life-Cycle Costs: 1) wgted market segments , 2) w/nat. ave. energy price					2010 Ave. Energy Price=		$0.067
1) Wgted LCC	$28,399	$28,399	$27,145	$26,988	$26,980	$26,888	$26,705
2) LCC/ave energy price	$28,031	$28,031	$26,823	$26,669	$26,663	$26,575	$26,397
Measures of Investment Performance For Efficiency Levels Exceeding EPCA 1992 (for Year 2010)							
Based on National Average Values for Unit Consumption and Energy Price--Relative to EPCA 1992							
	Payback Period (yrs)		5.2	4.9	5.2	5.1	5.0
	Cost of Saved Energy ($/kWh)		$0.034	$0.032	$0.033	$0.033	$0.032
	NPV (= LCC Savings) ($)		$1,208	$1,361	$1,367	$1,456	$1,633
	Internal Rate of Return		18.1%	19.4%	18.3%	18.5%	18.9%
Based on National Average Values for Unit Consumption and Energy Price--Relative to Standard 90.1-1999							
	Payback Period (yrs)		NA	0.0	4.8	4.6	4.3
	Cost of Saved Energy ($/kWh)		NA	$0.000	$0.031	$0.030	$0.028
	NPV (= LCC Savings) ($)		$0	$153	$160	$248	$426
	Internal Rate of Return		NA	NA	19.7%	20.9%	22.3%
	Break-even cost multiplier			NA	2.103	2.214	2.352
		Aggregate Measures					
National Energy Consumption			**Trillion Btu (Primary)**				
2010	1.4	1.4	1.2	1.2	1.2	1.2	1.1
2020	3.3	3.3	2.9	2.9	2.8	2.8	2.8
2030	3.8	3.8	3.3	3.3	3.3	3.3	3.2
Cumulative, 2004-2030	67.1	67.1	58.6	58.0	57.5	57.0	56.0
Emissions			**Million Metric Tons**				
Carbon (MMtons)	1.0	1.0	0.9	0.9	0.9	0.9	0.9
NOX (MMtons)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Discounted LCC for Nation			**Millions of 1998 $**				
from Market Segments	254.9	254.9	246.5	245.4	245.4	244.8	243.5
National NPV							
Relative to EPCA 1992			8.4	9.5	9.5	10.2	11.4
Relative to 90.1-1999				1.1	1.1	1.7	3.0
Quick Calc with National Averages (2010)	***(Note: Energy price fixed at 2010 value)***						
Energy Price ($/kWh),	$0.067	$0.067	$0.067	$0.067	$0.067	$0.067	$0.067
Ann. energy use (kWh)	28,821	28,821	25,153	24,926	24,703	24,485	24,059
Standby Losses (kWh)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy cost, $/yr	$1,926	$1,926	$1,681	$1,666	$1,651	$1,636	$1,608
PV (energy cost)	$19,908	$19,908	$17,374	$17,217	$17,064	$16,913	$16,619
Equipment Cost	$8,511	$8,511	$9,788	$9,788	$9,932	$9,992	$10,102
Unit LCC	$28,418	$28,418	$27,161	$27,005	$26,996	$26,904	$26,721
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Product:	**Packaged Terminal AC, <7 kBtu/h**						
Output Capacity (Btu/hr)	6,000			Estimated Shipments in 1999			18,000
Lifetime (years)	15			Projected Shipments, 2004-2030			577,684
Equip. Price Markup	25%						
Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	New Construction	90.1-1999 Tier 2	0	0
EER	8.9	8.9	9.4	11.0	11.2	0.0	11.6
Standby Loss (NA)	0	0	0	0	0	0	0
Equip. Price (w/o markup)	$585	$585	$597	$687	$713	$776	NA
Equip. Price (w/ markup)	$731	$731	$746	$858	$892	$971	NA
Year of Standard	NA	NA	2004	2004	2004	2004	2004
LIFE CYCLE COST (LCC) SAVINGS, for 2010				**1998 Dollars per Unit**			
Savings relative to EPCA 1992							
Weighted Average LCC Savings			$26	$15	-$5	NA	NA
Max LCC Savings			$79	$196	$191	NA	NA
Min LCC Savings			-$5	-$95	-$125	NA	NA
Percentage of units with LCC savings > 0			99.8%	52.4%	40.2%	0.0%	0.0%
NATIONAL ENERGY SAVINGS				**Trillion Btu (Primary)**			
Relative to EPCA 1992							
2010			0.1	0.3	0.4	NA	0.4
2020			0.2	0.7	0.8	NA	0.9
2030			0.2	0.7	0.8	NA	0.9
2004-2030			4.2	14.4	15.7	NA	17.5
Relative to Standard 90.1-1999							
2010				0.2	0.3	NA	0.3
2020				0.5	0.6	NA	0.7
2030				0.5	0.6	NA	0.7
2004-2030				10.2	11.5	NA	13.3
EMISSIONS REDUCTIONS (2004-2030)				**Million Metric Tons**			
Relative to EPCA 1992							
Carbon Equivalent			0.1	0.2	0.2	NA	0.3
NOx			0.00	0.00	0.00	NA	0.00
Relative to Standard 90.1-1999							
Carbon Equivalent				0.2	0.2	NA	0.2
NOx				0.00	0.00	NA	0.00
NET PRESENT VALUE (NPV) @ Discount Rate of		7.0%		**Million 1998 Dollars**			
Relative to EPCA 1992			$5.3	$3.1	-$1.1	NA	NA
Relative to Standard 90.1-1999				-$2.2	-$6.4	NA	NA
Adjust AEO Fuel Prices:	Multiplier:	1.05	Adder ($/kWh):		$0.000		
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Product:	Packaged Terminal AC, <7 kBtu/h				*Supplemental Results*		
Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	90.1-1999 - New Construction	90.1-1999 Tier 2	0	0
EER	8.9	8.9	9.4	11.0	11.2	0.0	11.6
Key Results: Per Unit Basis							
Input Capacity (kW)	0.676	0.676	0.638	0.545	0.534	NA	0.517
National Ave FLEOH	1,787.5	1,787.5	1,787.5	1,787.5	1,787.5	1,787.5	1,787.5
Life-Cycle Costs: 1) wgted market segments , 2) w/nat. ave. energy price					2010 Ave. Energy Price=		$0.067
1) Wgted LCC	$1,467	$1,467	$1,441	$1,452	$1,473	NA	NA
2) LCC/ave energy price	$1,453	$1,453	$1,427	$1,440	$1,461	NA	NA
Measures of Investment Performance For Efficiency Levels Exceeding EPCA 1992 (for Year 2010)							
Based on National Average Values for Unit Consumption and Energy Price--Relative to EPCA 1992							
Payback Period (yrs)			3.3	8.1	9.4	NA	NA
Cost of Saved Energy ($/kWh)			$0.024	$0.060	$0.069	NA	NA
NPV (= LCC Savings) ($)			$26	$13	-$8	NA	NA
Internal Rate of Return			29.5%	8.5%	6.1%	NA	NA
Based on National Average Values for Unit Consumption and Energy Price--Relative to Standard 90.1-1999							
Payback Period (yrs)			NA	10.1	11.7	NA	NA
Cost of Saved Energy ($/kWh)			NA	$0.074	$0.086	NA	NA
NPV (= LCC Savings) ($)			$0	-$13	-$34	NA	NA
Internal Rate of Return			NA	5.1%	3.0%	NA	NA
Break-even cost multiplier				0.882	0.765	NA	NA
Aggregate Measures							
National Energy Consumption			**Trillion Btu (Primary)**				
2010	1.7	1.7	1.6	1.4	1.4	NA	1.3
2020	3.7	3.7	3.5	3.0	2.9	NA	2.8
2030	3.9	3.9	3.7	3.1	3.1	NA	3.0
Cumulative, 2004-2030	74.7	74.7	70.5	60.3	59.0	NA	57.2
Emissions				**Million Metric Tons**			
Carbon (MMtons)	1.1	1.1	1.1	0.9	0.9	NA	0.9
NOX (MMtons)	0.0	0.0	0.0	0.0	0.0	NA	0.0
Discounted LCC for Nation				**Millions of 1998 $**			
from Market Segments	394.6	394.6	389.2	391.5	395.6	NA	NA
National NPV							
Relative to EPCA 1992			5.3	3.1	-1.1	NA	NA
Relative to 90.1-1999				-2.2	-6.4	NA	NA

Quick Calc with National Averages (2010) ***(Note: Energy price fixed at 2010 value)***

Energy Price ($/kWh),	$0.067	$0.067	$0.067	$0.067	$0.067	$0.067	$0.067
Ann. energy use (kWh)	1,208	1,208	1,140	974	954	NA	925
Standby Losses (kWh)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy cost, $/yr	$81	$81	$76	$65	$64	NA	$62
PV (energy cost)	$735	$735	$694	$593	$581	NA	$563
Equipment Cost	$731	$731	$746	$858	$892	$971	NA
Unit LCC	$1,467	$1,467	$1,440	$1,451	$1,472	NA	NA
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Product:	Packaged Terminal AC, 7-10 kBtu/h						
Output Capacity (Btu/hr)	8,500			Estimated Shipments in 1999			93,000
Lifetime (years)	15			Projected Shipments, 2004-2030			2,984,702
Equip. Price Markup	25%						

Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	New Construction	90.1-1999 Tier 2	ASHRAE Curve	0
EER	8.6	8.6	9.0	10.6	10.8	11.5	11.5
Standby Loss (NA)	0	0	0	0	0	0	0
Equip. Price (w/o markup)	$641	$641	$656	$725	$741	$831	$831
Equip. Price (w/ markup)	$801	$801	$820	$907	$927	$1,039	$1,039
Year of Standard	NA	NA	2004	2004	2004	2004	2004
LIFE CYCLE COST (LCC) SAVINGS, for 2010				**1998 Dollars per Unit**			
Savings relative to EPCA 1992							
Weighted Average LCC Savings			$32	$101	$101	$39	$39
Max LCC Savings			$96	$364	$389	$390	$390
Min LCC Savings			-$8	-$59	-$74	-$175	-$175
Percentage of units with LCC savings > 0			99.7%	90.7%	89.4%	58.9%	58.9%
NATIONAL ENERGY SAVINGS				**Trillion Btu (Primary)**			
Relative to EPCA 1992							
2010			0.6	2.5	2.7	3.3	3.3
2020			1.3	5.4	5.9	7.2	7.2
2030			1.4	5.6	6.2	7.5	7.5
2004-2030			26.7	108.4	118.8	145.0	145.0
Relative to Standard 90.1-1999							
2010				1.9	2.1	2.7	2.7
2020				4.0	4.6	5.9	5.9
2030				4.2	4.8	6.1	6.1
2004-2030				81.7	92.1	118.3	118.3
EMISSIONS REDUCTIONS (2004-2030)				**Million Metric Tons**			
Relative to EPCA 1992							
Carbon Equivalent			0.4	1.6	1.7	2.1	2.1
NOx			0.00	0.01	0.02	0.02	0.02
Relative to Standard 90.1-1999							
Carbon Equivalent				1.2	1.4	1.7	1.7
NOx				0.01	0.01	0.02	0.02
NET PRESENT VALUE (NPV) @ Discount Rate of		7.0%		**Million 1998 Dollars**			
Relative to EPCA 1992			$33.0	$105.2	$105.0	$40.4	$40.4
Relative to Standard 90.1-1999				$72.2	$72.0	$7.4	$7.4

Adjust AEO Fuel Prices:	Multiplier:	1.05	Adder ($/kWh):	$0.000
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Product: **Packaged Terminal AC, 7-10 kBtu/h** ***Supplemental Results***

Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	90.1-1999 - New Construction	90.1-1999 Tier 2	EndPoint ASHRAE Curve	0
EER	8.6	8.6	9.0	10.6	10.8	11.5	11.5
Key Results: Per Unit Basis							
Input Capacity (kW)	0.993	0.993	0.946	0.803	0.785	0.739	0.739
National Ave FLEOH	1,787.5	1,787.5	1,787.5	1,787.5	1,787.5	1,787.5	1,787.5
Life-Cycle Costs: 1) wgted market segments , 2) w/nat. ave. energy price					2010 Ave. Energy Price=		$0.067
1) Wgted LCC	$1,882	$1,882	$1,851	$1,782	$1,782	$1,844	$1,844
2) LCC/ave energy price	$1,861	$1,861	$1,831	$1,764	$1,765	$1,828	$1,828
Measures of Investment Performance For Efficiency Levels Exceeding EPCA 1992 (for Year 2010)							
Based on National Average Values for Unit Consumption and Energy Price--Relative to EPCA 1992							
Payback Period (yrs)			3.4	4.7	5.1	7.8	7.8
Cost of Saved Energy ($/kWh)			$0.025	$0.034	$0.037	$0.058	$0.058
NPV (= LCC Savings) ($)			$31	$97	$96	$33	$33
Internal Rate of Return			27.9%	19.7%	17.8%	9.1%	9.1%
Based on National Average Values for Unit Consumption and Energy Price--Relative to Standard 90.1-1999							
Payback Period (yrs)			NA	5.1	5.5	8.8	8.8
Cost of Saved Energy ($/kWh)			NA	$0.037	$0.041	$0.065	$0.065
NPV (= LCC Savings) ($)			$0	$66	$66	$2	$2
Internal Rate of Return			NA	17.8%	15.8%	7.2%	7.2%
Break-even cost multiplier				1.766	1.616	1.011	1.011
Aggregate Measures							
National Energy Consumption			**Trillion Btu (Primary)**				
2010	13.0	13.0	12.4	10.5	10.3	9.7	9.7
2020	28.1	28.1	26.8	22.7	22.2	20.9	20.9
2030	29.4	29.4	28.0	23.8	23.3	21.9	21.9
Cumulative, 2004-2030	567.2	567.2	540.5	458.8	448.4	422.2	422.2
Emissions				**Million Metric Tons**			
Carbon (MMtons)	8.7	8.7	8.3	7.1	7.0	6.6	6.6
NOX (MMtons)	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Discounted LCC for Nation				**Millions of 1998 $**			
from Market Segments	2,617.6	2,617.6	2,584.6	2,512.4	2,512.6	2,577.2	2,577.2
National NPV							
Relative to EPCA 1992			33.0	105.2	105.0	40.4	40.4
Relative to 90.1-1999				72.2	72.0	7.4	7.4

Quick Calc with National Averages (2010) ***(Note: Energy price fixed at 2010 value)***

Energy Price ($/kWh),	$0.067	$0.067	$0.067	$0.067	$0.067	$0.067	$0.067
Ann. energy use (kWh)	1,775	1,775	1,691	1,436	1,403	1,321	1,321
Standby Losses (kWh)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy cost, $/yr	$119	$119	$113	$96	$94	$88	$88
PV (energy cost)	$1,080	$1,080	$1,030	$874	$854	$804	$804
Equipment Cost	$801	$801	$820	$907	$927	$1,039	$1,039
Unit LCC	$1,882	$1,882	$1,850	$1,781	$1,781	$1,843	$1,843
Report created:	3/31/00 10:54 AM						

Product: **Packaged Terminal AC, 10-13 kBtu/h**

Output Capacity (Btu/hr)	11,500	Estimated Shipments in 1999	97,000
Lifetime (years)	15	Projected Shipments, 2004-2030	3,113,077
Equip. Price Markup	25%		

Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	New Construction	90.1-1999 Tier 2	ASHRAE Curve	0
EER	8.1	8.1	8.3	9.9	10.2	10.5	10.7
Standby Loss (NA)	0	0	0	0	0	0	0
Equip. Price (w/o markup)	$565	$565	$582	$704	$725	$753	
Equip. Price (w/ markup)	$706	$706	$728	$879	$906	$942	NA
Year of Standard	NA	NA	2004	2004	2004	2004	2004
LIFE CYCLE COST (LCC) SAVINGS, for 2010				**1998 Dollars per Unit**			
Savings relative to EPCA 1992							
Weighted Average LCC Savings			$27	$117	$122	$121	NA
Max LCC Savings			$89	$486	$532	$575	NA
Min LCC Savings			-$11	-$108	-$127	-$155	NA
Percentage of units with LCC savings > 0			95.6%	85.0%	81.7%	79.9%	0.0%
NATIONAL ENERGY SAVINGS				**Trillion Btu (Primary)**			
Relative to EPCA 1992							
2010			0.6	3.6	4.0	4.5	4.8
2020			1.3	7.9	8.7	9.7	10.3
2030			1.4	8.2	9.2	10.1	10.8
2004-2030			26.8	159.0	176.5	195.4	207.6
Relative to Standard 90.1-1999							
2010				3.0	3.4	3.9	4.1
2020				6.5	7.4	8.4	9.0
2030				6.9	7.8	8.7	9.4
2004-2030				132.1	149.7	168.6	180.8
EMISSIONS REDUCTIONS (2004-2030)				**Million Metric Tons**			
Relative to EPCA 1992							
Carbon Equivalent			0.4	2.3	2.6	2.9	3.1
NOx			0.00	0.02	0.02	0.03	0.03
Relative to Standard 90.1-1999							
Carbon Equivalent				1.9	2.2	2.5	2.7
NOx				0.02	0.02	0.02	0.02
NET PRESENT VALUE (NPV) @ Discount Rate of		7.0%		**Million 1998 Dollars**			
Relative to EPCA 1992			$29.5	$127.2	$132.9	$132.2	NA
Relative to Standard 90.1-1999				$97.6	$103.4	$102.7	NA

Adjust AEO Fuel Prices:	Multiplier:	1.05	Adder ($/kWh):	$0.000
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Product:	**Packaged Terminal AC, 10-13 kBtu/h**					***Supplemental Results***	
Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	90.1-1999 - New Construction	90.1-1999 Tier 2	EndPoint ASHRAE Curve	0
EER	8.1	8.1	8.3	9.9	10.2	10.5	10.7
			Key Results: Per Unit Basis				
Input Capacity (kW)	1.423	1.423	1.378	1.156	1.127	1.095	1.075
National Ave FLEOH	1,787.5	1,787.5	1,787.5	1,787.5	1,787.5	1,787.5	1,787.5
Life-Cycle Costs: 1) wgted market segments , 2) w/nat. ave. energy price					2010 Ave. Energy Price=		$0.067
1) Wgted LCC	$2,256	$2,256	$2,229	$2,139	$2,134	$2,134	NA
2) LCC/ave energy price	$2,226	$2,226	$2,199	$2,114	$2,110	$2,111	NA
Measures of Investment Performance For Efficiency Levels Exceeding EPCA 1992 (for Year 2010)							
Based on National Average Values for Unit Consumption and Energy Price--Relative to EPCA 1992							
Payback Period (yrs)			4.1	5.4	5.7	6.0	NA
Cost of Saved Energy ($/kWh)			$0.030	$0.040	$0.042	$0.044	NA
NPV (= LCC Savings) ($)			$26	$111	$116	$115	NA
Internal Rate of Return			23.1%	16.1%	15.3%	14.1%	NA
Based on National Average Values for Unit Consumption and Energy Price--Relative to Standard 90.1-1999							
Payback Period (yrs)			NA	5.7	6.0	6.3	NA
Cost of Saved Energy ($/kWh)			NA	$0.042	$0.044	$0.046	NA
NPV (= LCC Savings) ($)			$0	$85	$90	$88	NA
Internal Rate of Return			NA	15.1%	14.3%	13.1%	NA
Break-even cost multiplier				1.560	1.502	1.413	NA
		Aggregate Measures					
National Energy Consumption			**Trillion Btu (Primary)**				
2010	19.4	19.4	18.8	15.8	15.4	15.0	14.7
2020	42.0	42.0	40.7	34.1	33.3	32.3	31.7
2030	44.0	44.0	42.6	35.7	34.8	33.8	33.2
Cumulative, 2004-2030	848.0	848.0	821.2	689.0	671.5	652.5	640.3
Emissions				**Million Metric Tons**			
Carbon (MMtons)	13.0	13.0	12.6	10.7	10.4	10.1	10.0
NOX (MMtons)	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Discounted LCC for Nation				**Millions of 1998 $**			
from Market Segments	3,275.6	3,275.6	3,246.0	3,148.4	3,142.6	3,143.4	NA
National NPV							
Relative to EPCA 1992			29.5	127.2	132.9	132.2	NA
Relative to 90.1-1999				97.6	103.4	102.7	NA

Quick Calc with National Averages (2010) ***(Note: Energy price fixed at 2010 value)***

Energy Price ($/kWh),	$0.067	$0.067	$0.067	$0.067	$0.067	$0.067	$0.067
Ann. energy use (kWh)	2,544	2,544	2,464	2,067	2,015	1,958	1,921
Standby Losses (kWh)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy cost, $/yr	$170	$170	$165	$138	$135	$131	$128
PV (energy cost)	$1,549	$1,549	$1,500	$1,258	$1,226	$1,192	$1,169
Equipment Cost	$706	$706	$728	$879	$906	$942	NA
Unit LCC	$2,254	$2,254	$2,227	$2,138	$2,133	$2,133	NA
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Product: **Packaged Terminal AC, >13 kBtu/h**

Output Capacity (Btu/hr)	14,000	Estimated Shipments in 1999	44,000
Lifetime (years)	15	Projected Shipments, 2004-2030	1,412,117
Equip. Price Markup	25%		

Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	New Construction	90.1-1999 Tier 2	ASHRAE Curve	0
EER	7.8	7.8	7.9	9.5	9.8	10.0	10.0
Standby Loss (NA)	0	0	0	0	0	0	0
Equip. Price (w/o markup)	$717	$717	$721	$819	$872	$968	$968
Equip. Price (w/ markup)	$896	$896	$901	$1,024	$1,089	$1,209	$1,209
Year of Standard	NA	NA	2004	2004	2004	2004	2004

LIFE CYCLE COST (LCC) SAVINGS, for 2010	**1998 Dollars per Unit**				
Savings relative to EPCA 1992					
Weighted Average LCC Savings	$34	$235	$214	$127	$127
Max LCC Savings	$84	$696	$731	$686	$686
Min LCC Savings	$4	-$46	-$101	-$214	-$214
Percentage of units with LCC savings > 0	100.0%	99.8%	95.2%	70.3%	70.3%

NATIONAL ENERGY SAVINGS	**Trillion Btu (Primary)**				
Relative to EPCA 1992					
2010	0.2	2.1	2.3	2.5	2.5
2020	0.5	4.5	5.0	5.4	5.4
2030	0.5	4.7	5.2	5.7	5.7
2004-2030	9.7	90.1	101.0	109.2	109.2
Relative to Standard 90.1-1999					
2010		1.8	2.1	2.3	2.3
2020		4.0	4.5	4.9	4.9
2030		4.2	4.7	5.2	5.2
2004-2030		80.3	91.3	99.5	99.5

EMISSIONS REDUCTIONS (2004-2030)	**Million Metric Tons**				
Relative to EPCA 1992					
Carbon Equivalent	0.1	1.3	1.5	1.6	1.6
NOx	0.00	0.01	0.01	0.01	0.01
Relative to Standard 90.1-1999					
Carbon Equivalent		1.2	1.3	1.5	1.5
NOx		0.01	0.01	0.01	0.01

NET PRESENT VALUE (NPV) @ Discount Rate of 7.0%	**Million 1998 Dollars**				
Relative to EPCA 1992	$16.7	$115.7	$105.3	$62.5	$62.5
Relative to Standard 90.1-1999		$99.1	$88.6	$45.8	$45.8

Adjust AEO Fuel Prices: Multiplier: 1.05 Adder ($/kWh): $0.000

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Product:	**Packaged Terminal AC, >13 kBtu/h**				***Supplemental Results***		
Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	90.1-1999 - New Construction	90.1-1999 Tier 2	EndPoint ASHRAE Curve	0
EER	7.8	7.8	7.9	9.5	9.8	10.0	10.0
		Key Results: Per Unit Basis					
Input Capacity (kW)	1.804	1.804	1.768	1.471	1.430	1.400	1.400
National Ave FLEOH	1,787.5	1,787.5	1,787.5	1,787.5	1,787.5	1,787.5	1,787.5
Life-Cycle Costs: 1) wgted market segments , 2) w/nat. ave. energy price					2010 Ave. Energy Price=		$0.067
1) Wgted LCC	$2,861	$2,861	$2,827	$2,626	$2,647	$2,734	$2,734
2) LCC/ave energy price	$2,822	$2,822	$2,789	$2,595	$2,617	$2,704	$2,704
Measures of Investment Performance For Efficiency Levels Exceeding EPCA 1992 (for Year 2010)							
Based on National Average Values for Unit Consumption and Energy Price--Relative to EPCA 1992							
	Payback Period (yrs)		1.2	3.2	4.3	6.5	6.5
	Cost of Saved Energy ($/kWh)		$0.009	$0.024	$0.032	$0.048	$0.048
	NPV (= LCC Savings) ($)		$33	$228	$206	$118	$118
	Internal Rate of Return		79.2%	30.0%	21.5%	12.6%	12.6%
Based on National Average Values for Unit Consumption and Energy Price--Relative to Standard 90.1-1999							
	Payback Period (yrs)		NA	3.5	4.7	7.0	7.0
	Cost of Saved Energy ($/kWh)		NA	$0.025	$0.034	$0.051	$0.051
	NPV (= LCC Savings) ($)		$0	$195	$173	$85	$85
	Internal Rate of Return		NA	27.8%	19.7%	11.1%	11.1%
	Break-even cost multiplier			2.586	1.917	1.276	1.276
		Aggregate Measures					
National Energy Consumption			**Trillion Btu (Primary)**				
2010	11.2	11.2	10.9	9.1	8.9	8.7	8.7
2020	24.2	24.2	23.7	19.7	19.2	18.7	18.7
2030	25.3	25.3	24.8	20.6	20.0	19.6	19.6
Cumulative, 2004-2030	487.6	487.6	477.9	397.5	386.6	378.4	378.4
Emissions				**Million Metric Tons**			
Carbon (MMtons)	7.5	7.5	7.3	6.2	6.0	5.9	5.9
NOX (MMtons)	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Discounted LCC for Nation				**Millions of 1998 $**			
from Market Segments	1,884.2	1,884.2	1,867.5	1,768.5	1,778.9	1,821.7	1,821.7
National NPV							
Relative to EPCA 1992			16.7	115.7	105.3	62.5	62.5
Relative to 90.1-1999				99.1	88.6	45.8	45.8

Quick Calc with National Averages (2010) ***(Note: Energy price fixed at 2010 value)***

Energy Price ($/kWh),	$0.067	$0.067	$0.067	$0.067	$0.067	$0.067	$0.067
Ann. energy use (kWh)	3,225	3,225	3,161	2,629	2,557	2,503	2,503
Standby Losses (kWh)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy cost, $/yr	$216	$216	$211	$176	$171	$167	$167
PV (energy cost)	$1,963	$1,963	$1,924	$1,600	$1,556	$1,523	$1,523
Equipment Cost	$896	$896	$901	$1,024	$1,089	$1,209	$1,209
Unit LCC	$2,859	$2,859	$2,825	$2,624	$2,646	$2,733	$2,733
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Product:	Packaged Terminal HP, <7 kBtu/h						
Output Capacity (Btu/hr)	6,000			Estimated Shipments in 1999			16,000
Lifetime (years)	15			Projected Shipments, 2004-2030			513,497
Equip. Price Markup	25%						

Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	New Construction	90.1-1999 Tier 2	0	0
EER	8.9	8.9	9.3	10.8	11.0	0.0	11.6
Standby Loss (NA)	0	0	0	0	0	0	0
Equip. Price (w/o markup)	$649	$649	$658	$746	$776	$866	NA
Equip. Price (w/ markup)	$812	$812	$823	$932	$970	$1,082	NA
Year of Standard	NA	NA	2004	2004	2004	2004	2004
LIFE CYCLE COST (LCC) SAVINGS, for 2010				**1998 Dollars per Unit**			
Savings relative to EPCA 1992							
Weighted Average LCC Savings			$23	$11	-$15	NA	NA
Max LCC Savings			$66	$178	$169	NA	NA
Min LCC Savings			-$3	-$91	-$126	NA	NA
Percentage of units with LCC savings > 0			99.8%	48.6%	38.1%	0.0%	0.0%
NATIONAL ENERGY SAVINGS				**Trillion Btu (Primary)**			
Relative to EPCA 1992							
2010			0.1	0.3	0.3	NA	0.4
2020			0.2	0.6	0.6	NA	0.8
2030			0.2	0.6	0.7	NA	0.8
2004-2030			3.1	11.9	13.0	NA	15.6
Relative to Standard 90.1-1999							
2010				0.2	0.2	NA	0.3
2020				0.4	0.5	NA	0.6
2030				0.5	0.5	NA	0.6
2004-2030				8.8	10.0	NA	12.5
EMISSIONS REDUCTIONS (2004-2030)				**Million Metric Tons**			
Relative to EPCA 1992							
Carbon Equivalent			0.0	0.2	0.2	NA	0.2
NOx			0.00	0.00	0.00	NA	0.00
Relative to Standard 90.1-1999							
Carbon Equivalent				0.1	0.1	NA	0.2
NOx				0.00	0.00	NA	0.00
NET PRESENT VALUE (NPV) @ Discount Rate of		7.0%		**Million 1998 Dollars**			
Relative to EPCA 1992			$4.1	$2.0	-$2.6	NA	NA
Relative to Standard 90.1-1999				-$2.1	-$6.7	NA	NA

Adjust AEO Fuel Prices:	Multiplier:	1.05	Adder ($/kWh):	$0.000
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Product:	**Packaged Terminal HP, <7 kBtu/h**				***Supplemental Results***		
Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	90.1-1999 - New Construction	90.1-1999 Tier 2	0	0
EER	8.9	8.9	9.3	10.8	11.0	0.0	11.6
			Key Results: Per Unit Basis				
Input Capacity (kW)	0.676	0.676	0.645	0.555	0.543	NA	0.517
National Ave FLEOH	1,787.5	1,787.5	1,787.5	1,787.5	1,787.5	1,787.5	1,787.5
Life-Cycle Costs: 1) wgted market segments , 2) w/nat. ave. energy price					2010 Ave. Energy Price=		$0.067
1) Wgted LCC	$1,547	$1,547	$1,525	$1,536	$1,562	NA	NA
2) LCC/ave energy price	$1,533	$1,533	$1,511	$1,525	$1,550	NA	NA
Measures of Investment Performance For Efficiency Levels Exceeding EPCA 1992 (for Year 2010)							
Based on National Average Values for Unit Consumption and Energy Price--Relative to EPCA 1992							
Payback Period (yrs)			3.0	8.4	10.0	NA	NA
Cost of Saved Energy ($/kWh)			$0.022	$0.061	$0.074	NA	NA
NPV (= LCC Savings) ($)			$22	$8	-$17	NA	NA
Internal Rate of Return			32.6%	8.1%	5.2%	NA	NA
Based on National Average Values for Unit Consumption and Energy Price--Relative to Standard 90.1-1999							
Payback Period (yrs)			NA	10.2	12.2	NA	NA
Cost of Saved Energy ($/kWh)			NA	$0.075	$0.090	NA	NA
NPV (= LCC Savings) ($)			$0	-$14	-$40	NA	NA
Internal Rate of Return			NA	4.9%	2.4%	NA	NA
Break-even cost multiplier				0.874	0.732	NA	NA
		Aggregate Measures					
National Energy Consumption			**Trillion Btu (Primary)**				
2010	1.5	1.5	1.5	1.2	1.2	NA	1.2
2020	3.3	3.3	3.1	2.7	2.6	NA	2.5
2030	3.4	3.4	3.3	2.8	2.8	NA	2.6
Cumulative, 2004-2030	66.4	66.4	63.3	54.6	53.4	NA	50.8
Emissions				**Million Metric Tons**			
Carbon (MMtons)	1.0	1.0	1.0	0.8	0.8	NA	0.8
NOX (MMtons)	0.0	0.0	0.0	0.0	0.0	NA	0.0
Discounted LCC for Nation				**Millions of 1998 $**			
from Market Segments	369.8	369.8	365.7	367.8	372.4	NA	NA
National NPV							
Relative to EPCA 1992			4.1	2.0	-2.6	NA	NA
Relative to 90.1-1999				-2.1	-6.7	NA	NA

Quick Calc with National Averages (2010) ***(Note: Energy price fixed at 2010 value)***

Energy Price ($/kWh),	$0.067	$0.067	$0.067	$0.067	$0.067	$0.067	$0.067
Ann. energy use (kWh)	1,208	1,208	1,152	992	971	NA	925
Standby Losses (kWh)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy cost, $/yr	$81	$81	$77	$66	$65	NA	$62
PV (energy cost)	$735	$735	$701	$604	$591	NA	$563
Equipment Cost	$812	$812	$823	$932	$970	$1,082	NA
Unit LCC	$1,547	$1,547	$1,524	$1,536	$1,561	NA	NA
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Product: **Packaged Terminal HP, 7-10 kBtu/h**

Output Capacity (Btu/hr)	8,500	Estimated Shipments in 1999	89,000
Lifetime (years)	15	Projected Shipments, 2004-2030	2,856,328
Equip. Price Markup	25%		

Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	New Construction	90.1-1999 Tier 2	ASHRAE Curve	0
EER	8.6	8.6	8.9	10.4	10.6	11.4	11.5
Standby Loss (NA)	0	0	0	0	0	0	0
Equip. Price (w/o markup)	$706	$706	$727	$792	$802	$883	
Equip. Price (w/ markup)	$883	$883	$909	$989	$1,003	$1,103	NA
Year of Standard	NA	NA	2004	2004	2004	2004	2004

	Standard 90.1-1999	New Construction	90.1-1999 Tier 2	ASHRAE Curve	0
LIFE CYCLE COST (LCC) SAVINGS, for 2010		**1998 Dollars per Unit**			
Savings relative to EPCA 1992					
Weighted Average LCC Savings	$13	$83	$90	$49	NA
Max LCC Savings	$63	$324	$358	$391	NA
Min LCC Savings	-$18	-$64	-$72	-$159	NA
Percentage of units with LCC savings > 0	79.9%	89.4%	86.6%	64.8%	0.0%
NATIONAL ENERGY SAVINGS		**Trillion Btu (Primary)**			
Relative to EPCA 1992					
2010	0.5	2.2	2.4	3.1	3.2
2020	1.0	4.7	5.2	6.7	6.9
2030	1.0	4.9	5.5	7.0	7.2
2004-2030	19.7	95.3	105.6	135.2	138.8
Relative to Standard 90.1-1999					
2010		1.7	2.0	2.6	2.7
2020		3.7	4.3	5.7	5.9
2030		3.9	4.5	6.0	6.2
2004-2030		75.6	85.9	115.5	119.0
EMISSIONS REDUCTIONS (2004-2030)		**Million Metric Tons**			
Relative to EPCA 1992					
Carbon Equivalent	0.3	1.4	1.6	2.0	2.0
NOx	0.00	0.01	0.01	0.02	0.02
Relative to Standard 90.1-1999					
Carbon Equivalent		1.1	1.3	1.7	1.8
NOx		0.01	0.01	0.02	0.02
NET PRESENT VALUE (NPV) @ Discount Rate of 7.0%		**Million 1998 Dollars**			
Relative to EPCA 1992	$12.8	$82.9	$90.2	$48.8	NA
Relative to Standard 90.1-1999		$70.1	$77.4	$36.0	NA

Adjust AEO Fuel Prices: Multiplier: 1.05 Adder ($/kWh): $0.000

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Product:	Packaged Terminal HP, 7-10 kBtu/h				*Supplemental Results*		
Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	90.1-1999 - New Construction	90.1-1999 Tier 2	EndPoint ASHRAE Curve	0
EER	8.6	8.6	8.9	10.4	10.6	11.4	11.5
			Key Results: Per Unit Basis				
Input Capacity (kW)	0.993	0.993	0.957	0.819	0.800	0.746	0.739
National Ave FLEOH	1,787.5	1,787.5	1,787.5	1,787.5	1,787.5	1,787.5	1,787.5
Life-Cycle Costs: 1) wgted market segments , 2) w/nat. ave. energy price					2010 Ave. Energy Price=		$0.067
1) Wgted LCC	$1,964	$1,964	$1,951	$1,881	$1,874	$1,915	NA
2) LCC/ave energy price	$1,943	$1,943	$1,931	$1,864	$1,857	$1,900	NA
Measures of Investment Performance For Efficiency Levels Exceeding EPCA 1992 (for Year 2010)							
Based on National Average Values for Unit Consumption and Energy Price--Relative to EPCA 1992							
Payback Period (yrs)			6.1	5.1	5.2	7.5	NA
Cost of Saved Energy ($/kWh)			$0.045	$0.038	$0.038	$0.055	NA
NPV (= LCC Savings) ($)			$12	$79	$86	$43	NA
Internal Rate of Return			13.7%	17.5%	17.2%	10.0%	NA
Based on National Average Values for Unit Consumption and Energy Price--Relative to Standard 90.1-1999							
Payback Period (yrs)			NA	4.9	5.0	7.7	NA
Cost of Saved Energy ($/kWh)			NA	$0.036	$0.037	$0.056	NA
NPV (= LCC Savings) ($)			$0	$67	$74	$31	NA
Internal Rate of Return			NA	18.7%	18.1%	9.5%	NA
Break-even cost multiplier				1.838	1.793	1.162	NA
		Aggregate Measures					
National Energy Consumption			**Trillion Btu (Primary)**				
2010	12.4	12.4	12.0	10.3	10.0	9.3	9.3
2020	26.9	26.9	25.9	22.2	21.7	20.2	20.0
2030	28.2	28.2	27.1	23.2	22.7	21.1	21.0
Cumulative, 2004-2030	542.8	542.8	523.1	447.5	437.2	407.6	404.1
Emissions				**Million Metric Tons**			
Carbon (MMtons)	8.3	8.3	8.0	6.9	6.8	6.3	6.3
NOX (MMtons)	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Discounted LCC for Nation				**Millions of 1998 $**			
from Market Segments	2,612.9	2,612.9	2,600.1	2,530.0	2,522.7	2,564.1	NA
National NPV							
Relative to EPCA 1992			12.8	82.9	90.2	48.8	NA
Relative to 90.1-1999				70.1	77.4	36.0	NA

Quick Calc with National Averages (2010) ***(Note: Energy price fixed at 2010 value)***

Energy Price ($/kWh),	$0.067	$0.067	$0.067	$0.067	$0.067	$0.067	$0.067
Ann. energy use (kWh)	1,775	1,775	1,710	1,463	1,430	1,333	1,321
Standby Losses (kWh)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy cost, $/yr	$119	$119	$114	$98	$96	$89	$88
PV (energy cost)	$1,080	$1,080	$1,041	$891	$870	$811	$804
Equipment Cost	$883	$883	$909	$989	$1,003	$1,103	NA
Unit LCC	$1,963	$1,963	$1,950	$1,880	$1,873	$1,915	NA
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Product:	Packaged Terminal HP, 10-13 kBtu/h						
Output Capacity (Btu/hr)	11,500			Estimated Shipments in 1999			74,000
Lifetime (years)	15			Projected Shipments, 2004-2030			2,374,924
Equip. Price Markup	25%						
Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	New Construction	90.1-1999 Tier 2	ASHRAE Curve	0
EER	8.1	8.1	8.2	9.7	10.0	10.5	10.7
Standby Loss (NA)	0	0	0	0	0	0	0
Equip. Price (w/o markup)	$627	$627	$632	$720	$763	$878	
Equip. Price (w/ markup)	$784	$784	$790	$900	$954	$1,097	NA
Year of Standard	NA	NA	2004	2004	2004	2004	2004
LIFE CYCLE COST (LCC) SAVINGS, for 2010				**1998 Dollars per Unit**			
Savings relative to EPCA 1992							
Weighted Average LCC Savings			$25	$149	$128	$44	NA
Max LCC Savings			$64	$485	$507	$498	NA
Min LCC Savings			$1	-$56	-$102	-$232	NA
Percentage of units with LCC savings > 0			100.0%	96.5%	86.6%	56.5%	0.0%
NATIONAL ENERGY SAVINGS				**Trillion Btu (Primary)**			
Relative to EPCA 1992							
2010			0.3	2.5	2.9	3.4	3.6
2020			0.6	5.5	6.2	7.4	7.8
2030			0.7	5.7	6.5	7.7	8.2
2004-2030			12.9	110.5	124.4	149.1	158.4
Relative to Standard 90.1-1999							
2010				2.2	2.6	3.1	3.3
2020				4.8	5.5	6.8	7.2
2030				5.1	5.8	7.1	7.5
2004-2030				97.6	111.5	136.2	145.5
EMISSIONS REDUCTIONS (2004-2030)				**Million Metric Tons**			
Relative to EPCA 1992							
Carbon Equivalent			0.2	1.6	1.8	2.2	2.3
NOx			0.00	0.01	0.02	0.02	0.02
Relative to Standard 90.1-1999							
Carbon Equivalent				1.4	1.6	2.0	2.1
NOx				0.01	0.01	0.02	0.02
NET PRESENT VALUE (NPV) @ Discount Rate of		7.0%		**Million 1998 Dollars**			
Relative to EPCA 1992			$20.4	$123.3	$106.2	$36.6	NA
Relative to Standard 90.1-1999				$103.0	$85.9	$16.2	NA
Adjust AEO Fuel Prices:	Multiplier:	1.05	Adder ($/kWh):		$0.000		
Report created:	3/31/00 10:57 AM						

Product:	**Packaged Terminal HP, 10-13 kBtu/h**				***Supplemental Results***		
Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	90.1-1999 - New Construction	90.1-1999 Tier 2	EndPoint ASHRAE Curve	0
EER	8.1	8.1	8.2	9.7	10.0	10.5	10.7
		Key Results: Per Unit Basis					
Input Capacity (kW)	1.423	1.423	1.395	1.180	1.150	1.095	1.075
National Ave FLEOH	1,787.5	1,787.5	1,787.5	1,787.5	1,787.5	1,787.5	1,787.5
Life-Cycle Costs: 1) wgted market segments , 2) w/nat. ave. energy price					2010 Ave. Energy Price=		$0.067
1) Wgted LCC	$2,334	$2,334	$2,309	$2,185	$2,206	$2,290	NA
2) LCC/ave energy price	$2,303	$2,303	$2,279	$2,160	$2,181	$2,267	NA
Measures of Investment Performance For Efficiency Levels Exceeding EPCA 1992 (for Year 2010)							
Based on National Average Values for Unit Consumption and Energy Price--Relative to EPCA 1992							
Payback Period (yrs)			1.9	4.0	5.2	8.0	NA
Cost of Saved Energy ($/kWh)			$0.014	$0.029	$0.038	$0.059	NA
NPV (= LCC Savings) ($)			$24	$144	$122	$37	NA
Internal Rate of Return			53.2%	23.6%	17.2%	8.8%	NA
Based on National Average Values for Unit Consumption and Energy Price--Relative to Standard 90.1-1999							
Payback Period (yrs)			NA	4.3	5.6	8.6	NA
Cost of Saved Energy ($/kWh)			NA	$0.031	$0.041	$0.063	NA
NPV (= LCC Savings) ($)			$0	$120	$98	$13	NA
Internal Rate of Return			NA	21.8%	15.6%	7.7%	NA
Break-even cost multiplier				2.090	1.600	1.042	NA
		Aggregate Measures					
National Energy Consumption			**Trillion Btu (Primary)**				
2010	14.8	14.8	14.5	12.3	12.0	11.4	11.2
2020	32.1	32.1	31.4	26.6	25.9	24.7	24.2
2030	33.6	33.6	32.9	27.8	27.1	25.8	25.3
Cumulative, 2004-2030	646.9	646.9	634.0	536.4	522.5	497.8	488.5
Emissions				**Million Metric Tons**			
Carbon (MMtons)	9.9	9.9	9.7	8.3	8.1	7.7	7.6
NOX (MMtons)	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Discounted LCC for Nation			**Millions of 1998 $**				
from Market Segments	2,584.4	2,584.4	2,564.0	2,461.1	2,478.1	2,547.8	NA
National NPV							
Relative to EPCA 1992			20.4	123.3	106.2	36.6	NA
Relative to 90.1-1999				103.0	85.9	16.2	NA

Quick Calc with National Averages (2010) ***(Note: Energy price fixed at 2010 value)***

Energy Price ($/kWh),	$0.067	$0.067	$0.067	$0.067	$0.067	$0.067	$0.067
Ann. energy use (kWh)	2,544	2,544	2,493	2,110	2,055	1,958	1,921
Standby Losses (kWh)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy cost, $/yr	$170	$170	$167	$141	$137	$131	$128
PV (energy cost)	$1,549	$1,549	$1,518	$1,284	$1,251	$1,192	$1,169
Equipment Cost	$784	$784	$790	$900	$954	$1,097	NA
Unit LCC	$2,332	$2,332	$2,308	$2,184	$2,204	$2,289	NA
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Product: **Packaged Terminal HP, >13 kBtu/h**

Output Capacity (Btu/hr)	14,000	Estimated Shipments in 1999	37,000
Lifetime (years)	15	Projected Shipments, 2004-2030	1,187,462
Equip. Price Markup	25%		

Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	New Construction	90.1-1999 Tier 2	ASHRAE Curve	0
EER	7.8	7.8	7.8	9.3	9.6	10.0	10.0
Standby Loss (NA)	0	0	0	0	0	0	0
Equip. Price (w/o markup)	$765	$765	$767	$899	$944	$1,032	$1,032
Equip. Price (w/ markup)	$956	$956	$959	$1,124	$1,180	$1,290	$1,290
Year of Standard	NA	NA	2004	2004	2004	2004	2004
LIFE CYCLE COST (LCC) SAVINGS, for 2010			**1998 Dollars per Unit**				
Savings relative to EPCA 1992							
Weighted Average LCC Savings			$12	$160	$151	$106	$106
Max LCC Savings			$30	$578	$627	$665	$665
Min LCC Savings			$0	-$94	-$139	-$235	-$235
Percentage of units with LCC savings > 0			100.0%	90.7%	85.0%	66.4%	66.4%
NATIONAL ENERGY SAVINGS			**Trillion Btu (Primary)**				
Relative to EPCA 1992							
2010			0.1	1.6	1.8	2.1	2.1
2020			0.2	3.4	3.9	4.6	4.6
2030			0.2	3.6	4.1	4.8	4.8
2004-2030			3.0	68.6	78.2	91.8	91.8
Relative to Standard 90.1-1999							
2010				1.5	1.7	2.0	2.0
2020				3.2	3.7	4.4	4.4
2030				3.4	3.9	4.6	4.6
2004-2030				65.5	75.1	88.8	88.8
EMISSIONS REDUCTIONS (2004-2030)			**Million Metric Tons**				
Relative to EPCA 1992							
Carbon Equivalent			0.0	1.0	1.2	1.4	1.4
NOx			0.00	0.01	0.01	0.01	0.01
Relative to Standard 90.1-1999							
Carbon Equivalent				1.0	1.1	1.3	1.3
NOx				0.01	0.01	0.01	0.01
NET PRESENT VALUE (NPV) @ Discount Rate of		7.0%	**Million 1998 Dollars**				
Relative to EPCA 1992			$4.9	$66.5	$62.6	$43.9	$43.9
Relative to Standard 90.1-1999				$61.6	$57.8	$39.0	$39.0

Adjust AEO Fuel Prices:	Multiplier:	1.05	Adder ($/kWh):	$0.000
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Product:	Packaged Terminal HP, >13 kBtu/h				Supplemental Results		
Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	90.1-1999 - New Construction	90.1-1999 Tier 2	EndPoint ASHRAE Curve	0
EER	7.8	7.8	7.8	9.3	9.6	10.0	10.0
			Key Results: Per Unit Basis				
Input Capacity (kW)	1.804	1.804	1.791	1.502	1.460	1.400	1.400
National Ave FLEOH	1,787.5	1,787.5	1,787.5	1,787.5	1,787.5	1,787.5	1,787.5
Life-Cycle Costs: 1) wgted market segments , 2) w/nat. ave. energy price					2010 Ave. Energy Price=		$0.067
1) Wgted LCC	$2,921	$2,921	$2,909	$2,760	$2,770	$2,815	$2,815
2) LCC/ave energy price	$2,882	$2,882	$2,871	$2,728	$2,739	$2,785	$2,785
Measures of Investment Performance For Efficiency Levels Exceeding EPCA 1992 (for Year 2010)							
Based on National Average Values for Unit Consumption and Energy Price--Relative to EPCA 1992							
	Payback Period (yrs)		1.8	4.7	5.4	6.9	6.9
	Cost of Saved Energy ($/kWh)		$0.013	$0.034	$0.040	$0.051	$0.051
	NPV (= LCC Savings) ($)		$11	$154	$144	$97	$97
	Internal Rate of Return		55.1%	19.7%	16.2%	11.4%	11.4%
Based on National Average Values for Unit Consumption and Energy Price--Relative to Standard 90.1-1999							
	Payback Period (yrs)		NA	4.8	5.6	7.1	7.1
	Cost of Saved Energy ($/kWh)		NA	$0.035	$0.041	$0.052	$0.052
	NPV (= LCC Savings) ($)		$0	$142	$132	$86	$86
	Internal Rate of Return		NA	19.0%	15.6%	10.9%	10.9%
	Break-even cost multiplier			1.862	1.599	1.258	1.258
		Aggregate Measures					
National Energy Consumption			**Trillion Btu (Primary)**				
2010	9.4	9.4	9.3	7.8	7.6	7.3	7.3
2020	20.3	20.3	20.2	16.9	16.4	15.8	15.8
2030	21.3	21.3	21.1	17.7	17.2	16.5	16.5
Cumulative, 2004-2030	410.0	410.0	407.0	341.5	331.8	318.2	318.2
Emissions				**Million Metric Tons**			
Carbon (MMtons)	6.3	6.3	6.2	5.3	5.1	4.9	4.9
NOX (MMtons)	0.1	0.1	0.1	0.0	0.0	0.0	0.0
Discounted LCC for Nation				**Millions of 1998 $**			
from Market Segments	1,617.4	1,617.4	1,612.6	1,550.9	1,554.8	1,573.5	1,573.5
National NPV							
Relative to EPCA 1992			4.9	66.5	62.6	43.9	43.9
Relative to 90.1-1999				61.6	57.8	39.0	39.0

Quick Calc with National Averages (2010) ***(Note: Energy price fixed at 2010 value)***

Energy Price ($/kWh),	$0.067	$0.067	$0.067	$0.067	$0.067	$0.067	$0.067
Ann. energy use (kWh)	3,225	3,225	3,201	2,686	2,610	2,503	2,503
Standby Losses (kWh)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy cost, $/yr	$216	$216	$214	$179	$174	$167	$167
PV (energy cost)	$1,963	$1,963	$1,948	$1,635	$1,589	$1,523	$1,523
Equipment Cost	$956	$956	$959	$1,124	$1,180	$1,290	$1,290
Unit LCC	$2,919	$2,919	$2,907	$2,759	$2,768	$2,814	$2,814
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Product:	Pkg'd Boilers, Gas, 400 kBtu/h, HW						
Output Capacity (Btu/hr)	400,000			Estimated Shipments in 1999			2,821
Lifetime (years)	30			Projected Shipments, 2004-2030			90,536
Equip. Price Markup	25%						
Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	TestLevel1	TestLevel2	TestLevel3	MaxAvail
Thermal Efficiency (%)	75.0	75.0	75.0	78.0	79.0	81.0	88.0
Standby Loss (NA)	0	0	0	0	0	0	0
Equip. Price (w/o markup)	$3,972	$3,972	$3,972	$4,585	$5,262	$8,291	$12,636
Equip. Price (w/ markup)	$4,966	$4,966	$4,966	$5,732	$6,578	$10,364	$15,795
Year of Standard	NA	NA	2004	2004	2004	2004	2004
LIFE CYCLE COST (LCC) SAVINGS, for 2010				**1998 Dollars per Unit**			
Savings relative to EPCA 1992							
Weighted Average LCC Savings			$0	$566	$141	-$2,834	-$5,715
Max LCC Savings			$0	$3,122	$3,506	$2,089	$4,104
Min LCC Savings			$0	-$718	-$1,549	-$5,306	-$10,645
Percentage of units with LCC savings > 0			100.0%	81.3%	58.5%	4.6%	4.6%
NATIONAL ENERGY SAVINGS				**Trillion Btu (Primary)**			
Relative to EPCA 1992							
2010			0.0	0.5	0.6	0.9	1.8
2020			0.0	1.2	1.5	2.3	4.5
2030			0.0	2.0	2.6	3.8	7.5
2004-2030			0.0	26.3	34.7	50.7	101.1
Relative to Standard 90.1-1999							
2010				0.5	0.6	0.9	1.8
2020				1.2	1.5	2.3	4.5
2030				2.0	2.6	3.8	7.5
2004-2030				26.3	34.7	50.7	101.1
EMISSIONS REDUCTIONS (2004-2030)				**Million Metric Tons**			
Relative to EPCA 1992							
Carbon Equivalent			0.0	0.4	0.5	0.7	1.5
NOx			0.00	0.00	0.00	0.01	0.01
Relative to Standard 90.1-1999							
Carbon Equivalent				0.4	0.5	0.7	1.5
NOx				0.00	0.00	0.01	0.01
NET PRESENT VALUE (NPV) @ Discount Rate of		7.0%		**Million 1998 Dollars**			
Relative to EPCA 1992			$0.0	$17.9	$4.5	-$89.4	-$180.2
Relative to Standard 90.1-1999				$17.9	$4.5	-$89.4	-$180.2
Adjust AEO Fuel Prices:	Multiplier:	1.00	Adder ($/MMBtu):		$0.000		
Report created:	3/31/00 11:01 AM						

Product:	Pkg'd Boilers, Gas, 400 kBtu/h, HW				*Supplemental Results*		
Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	TestLevel1	TestLevel2	TestLevel3	MaxAvail
Thermal Efficiency (%)	75.0	75.0	75.0	78.0	79.0	81.0	88.0
Key Results: Per Unit Basis							
Input Capacity (MMBtu/hr)	0.533	0.533	0.533	0.513	0.506	0.494	0.455
National Ave FLEOH	952.2	952.2	952.2	952.2	952.2	952.2	952.2
Life-Cycle Costs: 1) wgted market segments , 2) w/nat. ave. energy price					2010 Ave. Energy Price=		$5.530
1) Wgted LCC	$39,588	$39,588	$39,588	$39,022	$39,447	$42,422	$45,303
2) LCC/ave energy price	$39,597	$39,597	$39,597	$39,032	$39,456	$42,431	$45,311
Measures of Investment Performance For Efficiency Levels Exceeding EPCA 1992 (for Year 2010)							
Based on National Average Values for Unit Consumption and Energy Price--Relative to EPCA 1992							
Payback Period (yrs)			NA	7.1	11.3	25.9	26.1
Cost of Saved Energy ($/MMBtu)			NA	$3.160	$5.052	$11.564	$11.632
NPV (= LCC Savings) ($)			$0	$566	$141	-$2,833	-$5,713
Internal Rate of Return			NA	13.7%	7.9%	0.9%	0.9%
Based on National Average Values for Unit Consumption and Energy Price--Relative to Standard 90.1-1999							
Payback Period (yrs)			NA	7.1	11.3	25.9	26.1
Cost of Saved Energy ($/MMBtu)			NA	$3.160	$5.052	$11.564	$11.632
NPV (= LCC Savings) ($)			$0	$566	$141	-$2,833	-$5,713
Internal Rate of Return			NA	13.7%	7.9%	0.9%	0.9%
Break-even cost multiplier				1.739	1.088	0.475	0.472
Aggregate Measures							
National Energy Consumption			**Trillion Btu (Primary)**				
2010	12.0	12.0	12.0	11.5	11.3	11.1	10.2
2020	30.5	30.5	30.5	29.4	29.0	28.3	26.0
2030	51.1	51.1	51.1	49.1	48.5	47.3	43.5
Cumulative, 2004-2030	684.4	684.4	684.4	658.0	649.7	633.7	583.3
Emissions				**Million Metric Tons**			
Carbon (MMtons)	10.2	10.2	10.2	9.8	9.7	9.4	8.7
NOX (MMtons)	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Discounted LCC for Nation				**Millions of 1998 $**			
from Market Segments	1,660.0	1,660.0	1,660.0	1,642.2	1,655.6	1,749.4	1,840.3
National NPV							
Relative to EPCA 1992			0.0	17.9	4.5	-89.4	-180.2
Relative to 90.1-1999				17.9	4.5	-89.4	-180.2

Quick Calc with National Averages (2010) ***(Note: Energy price fixed at 2010 value)***

	EPCA 1992	Market Baseline	Standard 90.1-1999	TestLevel1	TestLevel2	TestLevel3	MaxAvail
Energy Price ($/MMBtu)	$5.530	$5.530	$5.530	$5.530	$5.530	$5.530	$5.530
Ann. Energy Use (MMBtu)	508	508	508	488	482	470	433
Standby Losses (MMBtu)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy cost, $/yr	$2,809	$2,809	$2,809	$2,701	$2,666	$2,601	$2,394
PV (energy cost)	$34,853	$34,853	$34,853	$33,513	$33,088	$32,271	$29,704
Equipment Cost	$4,966	$4,966	$4,966	$5,732	$6,578	$10,364	$15,795
Unit LCC	$39,819	$39,819	$39,819	$39,244	$39,666	$42,635	$45,499
Report created:	3/31/00 11:01 AM						

Product: **Pkg'd Boilers, Gas, 800 kBtu/h, HW**

Output Capacity (Btu/hr)	800,000	Estimated Shipments in 1999	3,077
Lifetime (years)	30	Projected Shipments, 2004-2030	98,752
Equip. Price Markup	25%		

Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	TestLevel1	TestLevel2	TestLevel3	MaxAvail
Thermal Efficiency (%)	75.0	75.0	75.0	76.0	78.0	79.0	88.0
Standby Loss (NA)	0	0	0	0	0	0	0
Equip. Price (w/o markup)	$5,629	$5,629	$5,629	$6,220	$6,772	$8,908	$13,360
Equip. Price (w/ markup)	$7,037	$7,037	$7,037	$7,776	$8,465	$11,134	$16,700
Year of Standard	NA	NA	2004	2004	2004	2004	2004
LIFE CYCLE COST (LCC) SAVINGS, for 2010				**1998 Dollars per Unit**			
Savings relative to EPCA 1992							
Weighted Average LCC Savings			$0	$172	$1,235	-$592	$566
Max LCC Savings			$0	$1,921	$6,348	$6,139	$20,203
Min LCC Savings			$0	-$706	-$1,332	-$3,971	-$9,294
Percentage of units with LCC savings > 0			100.0%	59.9%	81.3%	24.0%	56.5%
NATIONAL ENERGY SAVINGS				**Trillion Btu (Primary)**			
Relative to EPCA 1992							
2010			0.0	0.3	1.0	1.3	3.9
2020			0.0	0.9	2.6	3.4	9.8
2030			0.0	1.5	4.3	5.6	16.5
2004-2030			0.0	19.6	57.4	75.6	220.5
Relative to Standard 90.1-1999							
2010				0.3	1.0	1.3	3.9
2020				0.9	2.6	3.4	9.8
2030				1.5	4.3	5.6	16.5
2004-2030				19.6	57.4	75.6	220.5
EMISSIONS REDUCTIONS (2004-2030)				**Million Metric Tons**			
Relative to EPCA 1992							
Carbon Equivalent			0.0	0.3	0.8	1.1	3.2
NOx			0.00	0.00	0.01	0.01	0.02
Relative to Standard 90.1-1999							
Carbon Equivalent				0.3	0.8	1.1	3.2
NOx				0.00	0.01	0.01	0.02
NET PRESENT VALUE (NPV) @ Discount Rate of		7.0%		**Million 1998 Dollars**			
Relative to EPCA 1992			$0.0	$5.9	$42.5	-$20.3	$19.6
Relative to Standard 90.1-1999				$5.9	$42.5	-$20.3	$19.6

Adjust AEO Fuel Prices:	Multiplier:	1.00	Adder ($/MMBtu):	$0.000
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Product: **Pkg'd Boilers, Gas, 800 kBtu/h, HW** ***Supplemental Results***

Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	TestLevel1	TestLevel2	TestLevel3	MaxAvail
Thermal Efficiency (%)	75.0	75.0	75.0	76.0	78.0	79.0	88.0
		Key Results: Per Unit Basis					
Input Capacity (MMBtu/hr)	1.067	1.067	1.067	1.053	1.026	1.013	0.909
National Ave FLEOH	952.2	952.2	952.2	952.2	952.2	952.2	952.2
Life-Cycle Costs: 1) wgted market segments , 2) w/nat. ave. energy price					2010 Ave. Energy Price=		$5.530
1) Wgted LCC	$76,282	$76,282	$76,282	$76,109	$75,047	$76,873	$75,716
2) LCC/ave energy price	$76,301	$76,301	$76,301	$76,128	$75,065	$76,891	$75,732
Measures of Investment Performance For Efficiency Levels Exceeding EPCA 1992 (for Year 2010)							
Based on National Average Values for Unit Consumption and Energy Price--Relative to EPCA 1992							
Payback Period (yrs)			NA	10.0	6.6	14.4	11.6
Cost of Saved Energy ($/MMBtu)			NA	$4.454	$2.946	$6.421	$5.190
NPV (= LCC Savings) ($)			$0	$173	$1,236	-$591	$569
Internal Rate of Return			NA	9.2%	14.8%	5.5%	7.6%
Based on National Average Values for Unit Consumption and Energy Price--Relative to Standard 90.1-1999							
Payback Period (yrs)			NA	10.0	6.6	14.4	11.6
Cost of Saved Energy ($/MMBtu)			NA	$4.454	$2.946	$6.421	$5.190
NPV (= LCC Savings) ($)			$0	$173	$1,236	-$591	$569
Internal Rate of Return			NA	9.2%	14.8%	5.5%	7.6%
Break-even cost multiplier				1.234	1.865	0.856	1.059
		Aggregate Measures					
National Energy Consumption			**Trillion Btu (Primary)**				
2010	26.1	26.1	26.1	25.7	25.1	24.8	22.2
2020	66.6	66.6	66.6	65.8	64.1	63.3	56.8
2030	111.4	111.4	111.4	110.0	107.2	105.8	95.0
Cumulative, 2004-2030	1,492.9	1,492.9	1,492.9	1,473.3	1,435.5	1,417.4	1,272.4
Emissions			**Million Metric Tons**				
Carbon (MMtons)	22.2	22.2	22.2	21.9	21.4	21.1	19.0
NOX (MMtons)	0.2	0.2	0.2	0.2	0.2	0.2	0.1
Discounted LCC for Nation			**Millions of 1998 $**				
from Market Segments	3,489.0	3,489.0	3,489.0	3,483.1	3,446.5	3,509.3	3,469.4
National NPV							
Relative to EPCA 1992			0.0	5.9	42.5	-20.3	19.6
Relative to 90.1-1999				5.9	42.5	-20.3	19.6

Quick Calc with National Averages (2010) ***(Note: Energy price fixed at 2010 value)***

	EPCA 1992	Market Baseline	Standard 90.1-1999	TestLevel1	TestLevel2	TestLevel3	MaxAvail
Energy Price ($/MMBtu)	$5.530	$5.530	$5.530	$5.530	$5.530	$5.530	$5.530
Ann. Energy Use (MMBtu)	1,016	1,016	1,016	1,002	977	964	866
Standby Losses (MMBtu)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy cost, $/yr	$5,617	$5,617	$5,617	$5,543	$5,401	$5,333	$4,788
PV (energy cost)	$69,706	$69,706	$69,706	$68,789	$67,025	$66,177	$59,409
Equipment Cost	$7,037	$7,037	$7,037	$7,776	$8,465	$11,134	$16,700
Unit LCC	$76,743	$76,743	$76,743	$76,564	$75,490	$77,311	$76,109
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Product:	**Pkg'd Boilers, Gas, 1500 kBtu/h, HW**						
Output Capacity (Btu/hr)	1,500,000			Estimated Shipments in 1999			540
Lifetime (years)	30			Projected Shipments, 2004-2030			17,331
Equip. Price Markup	25%						
Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	TestLevel1	TestLevel2	TestLevel3	MaxAvail
Thermal Efficiency (%)	75.0	75.0	75.0	77.0	78.0	79.0	88.0
Standby Loss (NA)	0	0	0	0	0	0	0
Equip. Price (w/o markup)	$8,502	$8,502	$8,502	$8,927	$9,452	$11,420	$15,293
Equip. Price (w/ markup)	$10,627	$10,627	$10,627	$11,159	$11,815	$14,275	$19,116
Year of Standard	NA	NA	2004	2004	2004	2004	2004
LIFE CYCLE COST (LCC) SAVINGS, for 2010				**1998 Dollars per Unit**			
Savings relative to EPCA 1992							
Weighted Average LCC Savings			$0	$2,841	$3,806	$2,926	$10,691
Max LCC Savings			$0	$9,315	$13,392	$15,546	$47,511
Min LCC Savings			$0	-$410	-$1,008	-$3,411	-$7,797
Percentage of units with LCC savings > 0			100.0%	99.6%	98.5%	81.3%	85.1%
NATIONAL ENERGY SAVINGS				**Trillion Btu (Primary)**			
Relative to EPCA 1992							
2010			0.0	0.2	0.3	0.4	1.3
2020			0.0	0.6	0.8	1.1	3.2
2030			0.0	1.0	1.4	1.9	5.4
2004-2030			0.0	12.8	18.9	24.9	72.6
Relative to Standard 90.1-1999							
2010				0.2	0.3	0.4	1.3
2020				0.6	0.8	1.1	3.2
2030				1.0	1.4	1.9	5.4
2004-2030				12.8	18.9	24.9	72.6
EMISSIONS REDUCTIONS (2004-2030)				**Million Metric Tons**			
Relative to EPCA 1992							
Carbon Equivalent			0.0	0.2	0.3	0.4	1.1
NOx			0.00	0.00	0.00	0.00	0.01
Relative to Standard 90.1-1999							
Carbon Equivalent				0.2	0.3	0.4	1.1
NOx				0.00	0.00	0.00	0.01
NET PRESENT VALUE (NPV) @ Discount Rate of		7.0%		**Million 1998 Dollars**			
Relative to EPCA 1992			$0.0	$17.2	$23.0	$17.7	$64.6
Relative to Standard 90.1-1999				$17.2	$23.0	$17.7	$64.6
Adjust AEO Fuel Prices:	Multiplier:	1.00	Adder ($/MMBtu):		$0.000		
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Product:	**Pkg'd Boilers, Gas, 1500 kBtu/h, HW**				***Supplemental Results***		
Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	TestLevel1	TestLevel2	TestLevel3	MaxAvail
Thermal Efficiency (%)	75.0	75.0	75.0	77.0	78.0	79.0	88.0
		Key Results: Per Unit Basis					
Input Capacity (MMBtu/hr)	2.000	2.000	2.000	1.948	1.923	1.899	1.705
National Ave FLEOH	952.2	952.2	952.2	952.2	952.2	952.2	952.2
Life-Cycle Costs: 1) wgted market segments , 2) w/nat. ave. energy price					2010 Ave. Energy Price=		$5.530
1) Wgted LCC	$140,462	$140,462	$140,462	$137,621	$136,656	$137,536	$129,770
2) LCC/ave energy price	$140,497	$140,497	$140,497	$137,655	$136,690	$137,569	$129,801
Measures of Investment Performance For Efficiency Levels Exceeding EPCA 1992 (for Year 2010)							
Based on National Average Values for Unit Consumption and Energy Price--Relative to EPCA 1992							
	Payback Period (yrs)		NA	1.9	2.9	6.8	5.5
	Cost of Saved Energy ($/MMBtu)		NA	$0.865	$1.307	$3.049	$2.431
	NPV (= LCC Savings) ($)		$0	$2,842	$3,807	$2,928	$10,697
	Internal Rate of Return		NA	51.3%	34.0%	14.3%	18.1%
Based on National Average Values for Unit Consumption and Energy Price--Relative to Standard 90.1-1999							
	Payback Period (yrs)		NA	1.9	2.9	6.8	5.5
	Cost of Saved Energy ($/MMBtu)		NA	$0.865	$1.307	$3.049	$2.431
	NPV (= LCC Savings) ($)		$0	$2,842	$3,807	$2,928	$10,697
	Internal Rate of Return		NA	51.3%	34.0%	14.3%	18.1%
	Break-even cost multiplier			6.350	4.205	1.803	2.260
		Aggregate Measures					
National Energy Consumption			**Trillion Btu (Primary)**				
2010	8.6	8.6	8.6	8.4	8.2	8.1	7.3
2020	21.9	21.9	21.9	21.4	21.1	20.8	18.7
2030	36.7	36.7	36.7	35.7	35.3	34.8	31.3
Cumulative, 2004-2030	491.3	491.3	491.3	478.5	472.4	466.4	418.7
Emissions				**Million Metric Tons**			
Carbon (MMtons)	7.3	7.3	7.3	7.1	7.0	6.9	6.3
NOX (MMtons)	0.1	0.1	0.1	0.1	0.1	0.1	0.0
Discounted LCC for Nation				**Millions of 1998 $**			
from Market Segments	1,127.5	1,127.5	1,127.5	1,110.3	1,104.5	1,109.8	1,062.9
National NPV							
Relative to EPCA 1992			0.0	17.2	23.0	17.7	64.6
Relative to 90.1-1999				17.2	23.0	17.7	64.6

Quick Calc with National Averages (2010) ***(Note: Energy price fixed at 2010 value)***

	EPCA 1992	Market Baseline	Standard 90.1-1999	TestLevel1	TestLevel2	TestLevel3	MaxAvail
Energy Price ($/MMBtu)	$5.530	$5.530	$5.530	$5.530	$5.530	$5.530	$5.530
Ann. Energy Use (MMBtu)	1,904	1,904	1,904	1,855	1,831	1,808	1,623
Standby Losses (MMBtu)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy cost, $/yr	$10,533	$10,533	$10,533	$10,259	$10,127	$9,999	$8,977
PV (energy cost)	$130,699	$130,699	$130,699	$127,304	$125,672	$124,081	$111,391
Equipment Cost	$10,627	$10,627	$10,627	$11,159	$11,815	$14,275	$19,116
Unit LCC	$141,326	$141,326	$141,326	$138,463	$137,487	$138,356	$130,507
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Product:	Pkg'd Boilers, Gas, 3000 kBtu/h, HW						
Output Capacity (Btu/hr)	3,000,000			Estimated Shipments in 1999			178
Lifetime (years)	30			Projected Shipments, 2004-2030			5,713
Equip. Price Markup	25%						

Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	TestLevel1	TestLevel2	TestLevel3	MaxAvail
Thermal Efficiency (%)	75.0	75.0	75.0	78.0	79.0	80.0	88.0
Standby Loss (NA)	0	0	0	0	0	0	0
Equip. Price (w/o markup)	$13,733	$13,733	$13,733	$15,107	$16,480	$16,755	$21,973
Equip. Price (w/ markup)	$17,167	$17,167	$17,167	$18,883	$20,600	$20,943	$27,467
Year of Standard	NA	NA	2004	2004	2004	2004	2004
LIFE CYCLE COST (LCC) SAVINGS, for 2010				**1998 Dollars per Unit**			
Savings relative to EPCA 1992							
Weighted Average LCC Savings			$0	$8,271	$9,714	$12,453	$28,060
Max LCC Savings			$0	$27,443	$34,954	$43,608	$101,699
Min LCC Savings			$0	-$1,357	-$2,959	-$3,191	-$8,917
Percentage of units with LCC savings > 0			100.0%	99.6%	98.0%	98.5%	98.0%
NATIONAL ENERGY SAVINGS				**Trillion Btu (Primary)**			
Relative to EPCA 1992							
2010			0.0	0.2	0.3	0.4	0.8
2020			0.0	0.6	0.7	0.9	2.1
2030			0.0	0.9	1.2	1.5	3.6
2004-2030			0.0	12.5	16.4	20.2	47.8
Relative to Standard 90.1-1999							
2010				0.2	0.3	0.4	0.8
2020				0.6	0.7	0.9	2.1
2030				0.9	1.2	1.5	3.6
2004-2030				12.5	16.4	20.2	47.8
EMISSIONS REDUCTIONS (2004-2030)				**Million Metric Tons**			
Relative to EPCA 1992							
Carbon Equivalent			0.0	0.2	0.2	0.3	0.7
NOx			0.00	0.00	0.00	0.00	0.01
Relative to Standard 90.1-1999							
Carbon Equivalent				0.2	0.2	0.3	0.7
NOx				0.00	0.00	0.00	0.01
NET PRESENT VALUE (NPV) @ Discount Rate of		7.0%		**Million 1998 Dollars**			
Relative to EPCA 1992			$0.0	$16.5	$19.3	$24.8	$55.9
Relative to Standard 90.1-1999				$16.5	$19.3	$24.8	$55.9

Adjust AEO Fuel Prices:	Multiplier:	1.00	Adder ($/MMBtu):	$0.000
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Product:	**Pkg'd Boilers, Gas, 3000 kBtu/h, HW**				***Supplemental Results***		
Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	TestLevel1	TestLevel2	TestLevel3	MaxAvail
Thermal Efficiency (%)	75.0	75.0	75.0	78.0	79.0	80.0	88.0
		Key Results: Per Unit Basis					
Input Capacity (MMBtu/hr)	4.000	4.000	4.000	3.846	3.797	3.750	3.409
National Ave FLEOH	952.2	952.2	952.2	952.2	952.2	952.2	952.2
Life-Cycle Costs: 1) wgted market segments , 2) w/nat. ave. energy price					2010 Ave. Energy Price=		$5.530
1) Wgted LCC	$276,835	$276,835	$276,835	$268,564	$267,120	$264,382	$248,775
2) LCC/ave energy price	$276,906	$276,906	$276,906	$268,633	$267,188	$264,449	$248,836
Measures of Investment Performance For Efficiency Levels Exceeding EPCA 1992 (for Year 2010)							
Based on National Average Values for Unit Consumption and Energy Price--Relative to EPCA 1992							
Payback Period (yrs)			NA	2.1	3.2	2.9	3.3
Cost of Saved Energy ($/MMBtu)			NA	$0.944	$1.435	$1.278	$1.475
NPV (= LCC Savings) ($)			$0	$8,273	$9,718	$12,457	$28,071
Internal Rate of Return			NA	47.0%	30.9%	34.7%	30.1%
Based on National Average Values for Unit Consumption and Energy Price--Relative to Standard 90.1-1999							
Payback Period (yrs)			NA	2.1	3.2	2.9	3.3
Cost of Saved Energy ($/MMBtu)			NA	$0.944	$1.435	$1.278	$1.475
NPV (= LCC Savings) ($)			$0	$8,273	$9,718	$12,457	$28,071
Internal Rate of Return			NA	47.0%	30.9%	34.7%	30.1%
Break-even cost multiplier				5.819	3.831	4.298	3.725
		Aggregate Measures					
National Energy Consumption			**Trillion Btu (Primary)**				
2010	5.7	5.7	5.7	5.4	5.4	5.3	4.8
2020	14.5	14.5	14.5	13.9	13.7	13.6	12.3
2030	24.2	24.2	24.2	23.2	23.0	22.7	20.6
Cumulative, 2004-2030	323.9	323.9	323.9	311.4	307.5	303.6	276.0
Emissions			**Million Metric Tons**				
Carbon (MMtons)	4.8	4.8	4.8	4.6	4.6	4.5	4.1
NOX (MMtons)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Discounted LCC for Nation			**Millions of 1998 $**				
from Market Segments	732.5	732.5	732.5	716.0	713.1	707.7	676.6
National NPV							
Relative to EPCA 1992			0.0	16.5	19.3	24.8	55.9
Relative to 90.1-1999				16.5	19.3	24.8	55.9
Quick Calc with National Averages (2010)	***(Note: Energy price fixed at 2010 value)***						
Energy Price ($/MMBtu)	$5.530	$5.530	$5.530	$5.530	$5.530	$5.530	$5.530
Ann. Energy Use (MMBtu)	3,809	3,809	3,809	3,662	3,616	3,571	3,246
Standby Losses (MMBtu)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy cost, $/yr	$21,065	$21,065	$21,065	$20,255	$19,999	$19,749	$17,953
PV (energy cost)	$261,398	$261,398	$261,398	$251,344	$248,162	$245,060	$222,782
Equipment Cost	$17,167	$17,167	$17,167	$18,883	$20,600	$20,943	$27,467
Unit LCC	$278,564	$278,564	$278,564	$270,227	$268,762	$266,004	$250,249
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Product: **Pkg'd Boilers, Gas, 400 kBtu/h, Steam**

Output Capacity (Btu/hr)	400,000	Estimated Shipments in 1999	1,268
Lifetime (years)	30	Projected Shipments, 2004-2030	40,695
Equip. Price Markup	25%		

Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	TestLevel1	TestLevel2	TestLevel3	MaxAvail
Thermal Efficiency (%)	72.0	72.0	75.0	76.0	77.0	79.0	82.0
Standby Loss (NA)	0	0	0	0	0	0	0
Equip. Price (w/o markup)	$5,460	$5,460	$6,006	$6,279	$7,207	$11,411	$13,322
Equip. Price (w/ markup)	$6,825	$6,825	$7,508	$7,849	$9,009	$14,264	$16,653
Year of Standard	NA	NA	2004	2004	2004	2004	2004
LIFE CYCLE COST (LCC) SAVINGS, for 2010			**1998 Dollars per Unit**				
Savings relative to EPCA 1992							
Weighted Average LCC Savings			$760	$874	$158	-$4,244	-$5,430
Max LCC Savings			$3,529	$4,518	$4,654	$1,891	$3,013
Min LCC Savings			-$630	-$955	-$2,100	-$7,324	-$9,669
Percentage of units with LCC savings > 0			85.1%	81.3%	56.5%	1.0%	1.0%
NATIONAL ENERGY SAVINGS			**Trillion Btu (Primary)**				
Relative to EPCA 1992							
2010			0.2	0.3	0.4	0.5	0.7
2020			0.6	0.8	0.9	1.3	1.7
2030			1.0	1.3	1.6	2.1	2.9
2004-2030			12.8	16.9	20.8	28.4	39.1
Relative to Standard 90.1-1999							
2010				0.1	0.1	0.3	0.5
2020				0.2	0.4	0.7	1.2
2030				0.3	0.6	1.2	2.0
2004-2030				4.0	8.0	15.6	26.3
EMISSIONS REDUCTIONS (2004-2030)			**Million Metric Tons**				
Relative to EPCA 1992							
Carbon Equivalent			0.2	0.2	0.3	0.4	0.6
NOx			0.00	0.00	0.00	0.00	0.00
Relative to Standard 90.1-1999							
Carbon Equivalent				0.1	0.1	0.2	0.4
NOx				0.00	0.00	0.00	0.00
NET PRESENT VALUE (NPV) @ Discount Rate of		7.0%	**Million 1998 Dollars**				
Relative to EPCA 1992			$10.8	$12.4	$2.3	-$60.2	-$77.0
Relative to Standard 90.1-1999				$1.6	-$8.5	-$70.9	-$87.8

Adjust AEO Fuel Prices:	Multiplier:	1.00	Adder ($/MMBtu):	$0.000
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Product:	**Pkg'd Boilers, Gas, 400 kBtu/h, Steam**				***Supplemental Results***		
Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	TestLevel1	TestLevel2	TestLevel3	MaxAvail
Thermal Efficiency (%)	72.0	72.0	75.0	76.0	77.0	79.0	82.0
		Key Results: Per Unit Basis					
Input Capacity (MMBtu/hr)	0.556	0.556	0.533	0.526	0.519	0.506	0.488
National Ave FLEOH	952.2	952.2	952.2	952.2	952.2	952.2	952.2
Life-Cycle Costs: 1) wgted market segments , 2) w/nat. ave. energy price					2010 Ave. Energy Price=		$5.530
1) Wgted LCC	$42,890	$42,890	$42,130	$42,016	$42,732	$47,134	$48,320
2) LCC/ave energy price	$42,900	$42,900	$42,139	$42,025	$42,741	$47,143	$48,329
Measures of Investment Performance For Efficiency Levels Exceeding EPCA 1992 (for Year 2010)							
Based on National Average Values for Unit Consumption and Energy Price--Relative to EPCA 1992							
Payback Period (yrs)			5.8	6.6	11.5	28.7	27.5
Cost of Saved Energy ($/MMBtu)			$2.599	$2.963	$5.123	$12.789	$12.276
NPV (= LCC Savings) ($)			$760	$875	$159	-$4,243	-$5,429
Internal Rate of Return			16.9%	14.7%	7.7%	0.2%	0.5%
Based on National Average Values for Unit Consumption and Energy Price--Relative to Standard 90.1-1999							
Payback Period (yrs)			NA	9.2	20.6	47.5	38.1
Cost of Saved Energy ($/MMBtu)			NA	$4.115	$9.173	$21.175	$17.000
NPV (= LCC Savings) ($)			$0	$114	-$602	-$5,003	-$6,189
Internal Rate of Return			NA	10.2%	2.6%	NA	-1.5%
Break-even cost multiplier				1.335	0.599	0.260	0.323
		Aggregate Measures					
National Energy Consumption			**Trillion Btu (Primary)**				
2010	5.6	5.6	5.4	5.3	5.2	5.1	4.9
2020	14.3	14.3	13.7	13.5	13.4	13.0	12.6
2030	23.9	23.9	23.0	22.7	22.4	21.8	21.0
Cumulative, 2004-2030	320.4	320.4	307.6	303.6	299.6	292.0	281.4
Emissions				**Million Metric Tons**			
Carbon (MMtons)	4.8	4.8	4.6	4.5	4.5	4.4	4.2
NOX (MMtons)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Discounted LCC for Nation				**Millions of 1998 $**			
from Market Segments	808.4	808.4	797.6	796.0	806.1	868.6	885.4
National NPV							
Relative to EPCA 1992			10.8	12.4	2.3	-60.2	-77.0
Relative to 90.1-1999				1.6	-8.5	-70.9	-87.8

Quick Calc with National Averages (2010) (Note: Energy price fixed at 2010 value)

	EPCA 1992	Market Baseline	Standard 90.1-1999	TestLevel1	TestLevel2	TestLevel3	MaxAvail
Energy Price ($/MMBtu)	$5.530	$5.530	$5.530	$5.530	$5.530	$5.530	$5.530
Ann. Energy Use (MMBtu)	529	529	508	501	495	482	465
Standby Losses (MMBtu)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy cost, $/yr	$2,926	$2,926	$2,809	$2,772	$2,736	$2,666	$2,569
PV (energy cost)	$36,305	$36,305	$34,853	$34,394	$33,948	$33,088	$31,878
Equipment Cost	$6,825	$6,825	$7,508	$7,849	$9,009	$14,264	$16,653
Unit LCC	$43,130	$43,130	$42,361	$42,243	$42,957	$47,353	$48,531
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Product:	Pkg'd Boilers, Gas, 800 kBtu/h, Steam						
Output Capacity (Btu/hr)	800,000			Estimated Shipments in 1999			1,731
Lifetime (years)	30			Projected Shipments, 2004-2030			55,554
Equip. Price Markup	25%						

Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	TestLevel1	TestLevel2	TestLevel3	MaxAvail
Thermal Efficiency (%)	72.0	72.0	75.0	76.0	78.0	79.0	82.0
Standby Loss (NA)	0	0	0	0	0	0	0
Equip. Price (w/o markup)	$7,248	$7,248	$8,335	$8,698	$11,452	$11,814	$16,308
Equip. Price (w/ markup)	$9,060	$9,060	$10,419	$10,872	$14,315	$14,768	$20,385
Year of Standard	NA	NA	2004	2004	2004	2004	2004
LIFE CYCLE COST (LCC) SAVINGS, for 2010				**1998 Dollars per Unit**			
Savings relative to EPCA 1992							
Weighted Average LCC Savings			$1,526	$1,984	$294	$683	-$2,529
Max LCC Savings			$7,065	$9,272	$10,945	$12,953	$14,357
Min LCC Savings			-$1,255	-$1,675	-$5,055	-$5,477	-$11,008
Percentage of units with LCC savings > 0			85.1%	85.1%	56.5%	58.5%	16.9%
NATIONAL ENERGY SAVINGS				**Trillion Btu (Primary)**			
Relative to EPCA 1992							
2010			0.6	0.8	1.2	1.4	1.9
2020			1.6	2.1	3.0	3.5	4.8
2030			2.6	3.4	5.0	5.8	8.0
2004-2030			35.0	46.0	67.3	77.5	106.7
Relative to Standard 90.1-1999							
2010				0.2	0.6	0.7	1.3
2020				0.5	1.4	1.9	3.2
2030				0.8	2.4	3.2	5.4
2004-2030				11.1	32.3	42.5	71.7
EMISSIONS REDUCTIONS (2004-2030)				**Million Metric Tons**			
Relative to EPCA 1992							
Carbon Equivalent			0.5	0.7	1.0	1.1	1.6
NOx			0.00	0.00	0.01	0.01	0.01
Relative to Standard 90.1-1999							
Carbon Equivalent				0.2	0.5	0.6	1.0
NOx				0.00	0.00	0.00	0.01
NET PRESENT VALUE (NPV) @ Discount Rate of		7.0%		**Million 1998 Dollars**			
Relative to EPCA 1992			$29.6	$38.4	$5.7	$13.3	-$48.9
Relative to Standard 90.1-1999				$8.9	-$23.8	-$16.3	-$78.5

Adjust AEO Fuel Prices:	Multiplier:	1.00	Adder ($/MMBtu):	$0.000
Report created:	3/31/00 11:04 AM			

Product:	**Pkg'd Boilers, Gas, 800 kBtu/h, Steam**				***Supplemental Results***		
Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	TestLevel1	TestLevel2	TestLevel3	MaxAvail
Thermal Efficiency (%)	72.0	72.0	75.0	76.0	78.0	79.0	82.0
		Key Results: Per Unit Basis					
Input Capacity (MMBtu/hr)	1.111	1.111	1.067	1.053	1.026	1.013	0.976
National Ave FLEOH	952.2	952.2	952.2	952.2	952.2	952.2	952.2
Life-Cycle Costs: 1) wgted market segments , 2) w/nat. ave. energy price					2010 Ave. Energy Price=		$5.530
1) Wgted LCC	$81,190	$81,190	$79,664	$79,206	$80,896	$80,507	$83,719
2) LCC/ave energy price	$81,210	$81,210	$79,683	$79,225	$80,915	$80,525	$83,736
Measures of Investment Performance For Efficiency Levels Exceeding EPCA 1992 (for Year 2010)							
Based on National Average Values for Unit Consumption and Energy Price--Relative to EPCA 1992							
	Payback Period (yrs)		5.8	5.9	11.7	11.0	15.9
	Cost of Saved Energy ($/MMBtu)		$2.588	$2.622	$5.203	$4.906	$7.073
	NPV (= LCC Savings) ($)		$1,527	$1,985	$295	$685	-$2,526
	Internal Rate of Return		17.0%	16.7%	7.6%	8.2%	4.7%
Based on National Average Values for Unit Consumption and Energy Price--Relative to Standard 90.1-1999							
	Payback Period (yrs)		NA	6.1	18.0	15.3	20.8
	Cost of Saved Energy ($/MMBtu)		NA	$2.732	$8.036	$6.814	$9.262
	NPV (= LCC Savings) ($)		$0	$458	-$1,232	-$842	-$4,053
	Internal Rate of Return		NA	16.0%	3.6%	5.0%	2.5%
	Break-even cost multiplier			2.012	0.684	0.806	0.593
		Aggregate Measures					
National Energy Consumption			**Trillion Btu (Primary)**				
2010	15.3	15.3	14.7	14.5	14.1	13.9	13.4
2020	39.0	39.0	37.5	37.0	36.0	35.6	34.3
2030	65.3	65.3	62.7	61.9	60.3	59.5	57.3
Cumulative, 2004-2030	874.9	874.9	839.9	828.8	807.6	797.3	768.2
Emissions				**Million Metric Tons**			
Carbon (MMtons)	13.0	13.0	12.5	12.3	12.0	11.9	11.5
NOX (MMtons)	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Discounted LCC for Nation				**Millions of 1998 $**			
from Market Segments	2,089.1	2,089.1	2,059.5	2,050.6	2,083.4	2,075.8	2,138.0
National NPV							
Relative to EPCA 1992			29.6	38.4	5.7	13.3	-48.9
Relative to 90.1-1999				8.9	-23.8	-16.3	-78.5

Quick Calc with National Averages (2010) ***(Note: Energy price fixed at 2010 value)***

	EPCA 1992	Market Baseline	Standard 90.1-1999	TestLevel1	TestLevel2	TestLevel3	MaxAvail
Energy Price ($/MMBtu)	$5.530	$5.530	$5.530	$5.530	$5.530	$5.530	$5.530
Ann. Energy Use (MMBtu)	1,058	1,058	1,016	1,002	977	964	929
Standby Losses (MMBtu)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy cost, $/yr	$5,851	$5,851	$5,617	$5,543	$5,401	$5,333	$5,138
PV (energy cost)	$72,610	$72,610	$69,706	$68,789	$67,025	$66,177	$63,756
Equipment Cost	$9,060	$9,060	$10,419	$10,872	$14,315	$14,768	$20,385
Unit LCC	$81,670	$81,670	$80,125	$79,661	$81,340	$80,944	$84,141
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Product:	Pkg'd Boilers, Gas, 1500 kBtu/h, Steam						
Output Capacity (Btu/hr)	1,500,000			Estimated Shipments in 1999			424
Lifetime (years)	30			Projected Shipments, 2004-2030			13,608
Equip. Price Markup	25%						
Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	TestLevel1	TestLevel2	TestLevel3	MaxAvail
Thermal Efficiency (%)	72.0	72.0	75.0	77.0	78.0	79.0	81.0
Standby Loss (NA)	0	0	0	0	0	0	0
Equip. Price (w/o markup)	$12,580	$12,580	$13,209	$15,443	$16,899	$17,704	$19,136
Equip. Price (w/ markup)	$15,726	$15,726	$16,512	$19,303	$21,123	$22,130	$23,920
Year of Standard	NA	NA	2004	2004	2004	2004	2004
LIFE CYCLE COST (LCC) SAVINGS, for 2010				**1998 Dollars per Unit**			
Savings relative to EPCA 1992							
Weighted Average LCC Savings			$4,624	$5,204	$5,006	$5,579	$6,832
Max LCC Savings			$15,009	$22,063	$24,977	$28,583	$35,680
Min LCC Savings			-$591	-$3,261	-$5,023	-$5,973	-$7,653
Percentage of units with LCC savings > 0			99.6%	89.3%	85.1%	81.3%	81.3%
NATIONAL ENERGY SAVINGS				**Trillion Btu (Primary)**			
Relative to EPCA 1992							
2010			0.3	0.5	0.5	0.6	0.8
2020			0.7	1.2	1.4	1.6	2.0
2030			1.2	1.9	2.3	2.7	3.3
2004-2030			16.1	26.1	30.9	35.6	44.6
Relative to Standard 90.1-1999							
2010				0.2	0.3	0.3	0.5
2020				0.4	0.7	0.9	1.3
2030				0.7	1.1	1.5	2.1
2004-2030				10.0	14.8	19.5	28.6
EMISSIONS REDUCTIONS (2004-2030)				**Million Metric Tons**			
Relative to EPCA 1992							
Carbon Equivalent			0.2	0.4	0.4	0.5	0.6
NOx			0.00	0.00	0.00	0.00	0.00
Relative to Standard 90.1-1999							
Carbon Equivalent				0.1	0.2	0.3	0.4
NOx				0.00	0.00	0.00	0.00
NET PRESENT VALUE (NPV) @ Discount Rate of		7.0%		**Million 1998 Dollars**			
Relative to EPCA 1992			$21.9	$24.7	$23.8	$26.5	$32.4
Relative to Standard 90.1-1999				$2.8	$1.8	$4.5	$10.5
Adjust AEO Fuel Prices:	Multiplier:	1.00	Adder ($/MMBtu):		$0.000		
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Product:	Pkg'd Boilers, Gas, 1500 kBtu/h, Steam				*Supplemental Results*		
Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	TestLevel1	TestLevel2	TestLevel3	MaxAvail
Thermal Efficiency (%)	72.0	72.0	75.0	77.0	78.0	79.0	81.0
Key Results: Per Unit Basis							
Input Capacity (MMBtu/hr)	2.083	2.083	2.000	1.948	1.923	1.899	1.852
National Ave FLEOH	952.2	952.2	952.2	952.2	952.2	952.2	952.2
Life-Cycle Costs: 1) wgted market segments , 2) w/nat. ave. energy price					2010 Ave. Energy Price=		$5.530
1) Wgted LCC	$150,969	$150,969	$146,346	$145,765	$145,964	$145,391	$144,137
2) LCC/ave energy price	$151,007	$151,007	$146,381	$145,800	$145,998	$145,425	$144,170
Measures of Investment Performance For Efficiency Levels Exceeding EPCA 1992 (for Year 2010)							
Based on National Average Values for Unit Consumption and Energy Price--Relative to EPCA 1992							
Payback Period (yrs)			1.8	5.0	6.4	6.6	6.7
Cost of Saved Energy ($/MMBtu)			$0.798	$2.238	$2.850	$2.936	$2.996
NPV (= LCC Savings) ($)			$4,625	$5,207	$5,009	$5,582	$6,837
Internal Rate of Return			55.7%	19.7%	15.3%	14.9%	14.5%
Based on National Average Values for Unit Consumption and Energy Price--Relative to Standard 90.1-1999							
Payback Period (yrs)			NA	10.2	11.4	10.5	9.5
Cost of Saved Energy ($/MMBtu)			NA	$4.548	$5.074	$4.696	$4.232
NPV (= LCC Savings) ($)			$0	$582	$383	$957	$2,211
Internal Rate of Return			NA	9.0%	7.8%	8.6%	9.8%
Break-even cost multiplier				1.208	1.083	1.170	1.298
Aggregate Measures							
National Energy Consumption			**Trillion Btu (Primary)**				
2010	7.0	7.0	6.7	6.6	6.5	6.4	6.2
2020	17.9	17.9	17.2	16.8	16.6	16.3	15.9
2030	30.0	30.0	28.8	28.0	27.7	27.3	26.7
Cumulative, 2004-2030	401.8	401.8	385.7	375.7	370.9	366.2	357.2
Emissions			**Million Metric Tons**				
Carbon (MMtons)	6.0	6.0	5.7	5.6	5.5	5.5	5.3
NOX (MMtons)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Discounted LCC for Nation			**Millions of 1998 $**				
from Market Segments	951.5	951.5	929.6	926.8	927.8	925.0	919.1
National NPV							
Relative to EPCA 1992			21.9	24.7	23.8	26.5	32.4
Relative to 90.1-1999				2.8	1.8	4.5	10.5

Quick Calc with National Averages (2010)   (Note: Energy price fixed at 2010 value)

Energy Price ($/MMBtu)	$5.530	$5.530	$5.530	$5.530	$5.530	$5.530	$5.530
Ann. Energy Use (MMBtu)	1,984	1,984	1,904	1,855	1,831	1,808	1,763
Standby Losses (MMBtu)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy cost, $/yr	$10,971	$10,971	$10,533	$10,259	$10,127	$9,999	$9,752
PV (energy cost)	$136,145	$136,145	$130,699	$127,304	$125,672	$124,081	$121,017
Equipment Cost	$15,726	$15,726	$16,512	$19,303	$21,123	$22,130	$23,920
Unit LCC	$151,870	$151,870	$147,210	$146,607	$146,795	$146,212	$144,938
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Product:	**Pkg'd Boilers, Gas, 3000 kBtu/h, Steam**						
Output Capacity (Btu/hr)	3,000,000			Estimated Shipments in 1999			135
Lifetime (years)	30			Projected Shipments, 2004-2030			4,333
Equip. Price Markup	25%						
Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	TestLevel1	TestLevel2	TestLevel3	MaxAvail
Thermal Efficiency (%)	72.0	72.0	72.0	78.0	79.0	80.0	82.0
Standby Loss (NA)	0	0	0	0	0	0	0
Equip. Price (w/o markup)	$18,026	$18,026	$18,026	$23,433	$24,335	$24,875	$28,120
Equip. Price (w/ markup)	$22,532	$22,532	$22,532	$29,292	$30,418	$31,094	$35,150
Year of Standard	NA	NA	2004	2004	2004	2004	2004
LIFE CYCLE COST (LCC) SAVINGS, for 2010				**1998 Dollars per Unit**			
Savings relative to EPCA 1992							
Weighted Average LCC Savings			$0	$14,047	$16,081	$18,487	$20,368
Max LCC Savings			$0	$53,989	$62,090	$70,411	$83,691
Min LCC Savings			$0	-$6,009	-$7,022	-$7,587	-$11,428
Percentage of units with LCC savings > 0			100.0%	97.7%	97.7%	97.7%	90.1%
NATIONAL ENERGY SAVINGS				**Trillion Btu (Primary)**			
Relative to EPCA 1992							
2010			0.0	0.3	0.4	0.4	0.5
2020			0.0	0.9	1.0	1.1	1.4
2030			0.0	1.5	1.7	1.9	2.3
2004-2030			0.0	19.7	22.7	25.6	31.2
Relative to Standard 90.1-1999							
2010				0.3	0.4	0.4	0.5
2020				0.9	1.0	1.1	1.4
2030				1.5	1.7	1.9	2.3
2004-2030				19.7	22.7	25.6	31.2
EMISSIONS REDUCTIONS (2004-2030)				**Million Metric Tons**			
Relative to EPCA 1992							
Carbon Equivalent			0.0	0.3	0.3	0.4	0.5
NOx			0.00	0.00	0.00	0.00	0.00
Relative to Standard 90.1-1999							
Carbon Equivalent				0.3	0.3	0.4	0.5
NOx				0.00	0.00	0.00	0.00
NET PRESENT VALUE (NPV) @ Discount Rate of		7.0%		**Million 1998 Dollars**			
Relative to EPCA 1992			$0.0	$21.2	$24.3	$27.9	$30.8
Relative to Standard 90.1-1999				$21.2	$24.3	$27.9	$30.8
Adjust AEO Fuel Prices:	Multiplier:	1.00	Adder ($/MMBtu):		$0.000		
Report created:	3/31/00 11:06 AM						

Product:	Pkg'd Boilers, Gas, 3000 kBtu/h, Steam				*Supplemental Results*		
Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	TestLevel1	TestLevel2	TestLevel3	MaxAvail
Thermal Efficiency (%)	72.0	72.0	72.0	78.0	79.0	80.0	82.0
			Key Results: Per Unit Basis				
Input Capacity (MMBtu/hr)	4.167	4.167	4.167	3.846	3.797	3.750	3.659
National Ave FLEOH	952.2	952.2	952.2	952.2	952.2	952.2	952.2
Life-Cycle Costs: 1) wgted market segments , 2) w/nat. ave. energy price					2010 Ave. Energy Price=		$5.530
1) Wgted LCC	$293,020	$293,020	$293,020	$278,973	$276,939	$274,533	$272,651
2) LCC/ave energy price	$293,094	$293,094	$293,094	$279,041	$277,007	$274,600	$272,717
Measures of Investment Performance For Efficiency Levels Exceeding EPCA 1992 (for Year 2010)							
Based on National Average Values for Unit Consumption and Energy Price--Relative to EPCA 1992							
	Payback Period (yrs)		NA	4.0	4.1	3.9	4.7
	Cost of Saved Energy ($/MMBtu)		NA	$1.785	$1.808	$1.739	$2.102
	NPV (= LCC Savings) ($)		$0	$14,053	$16,088	$18,494	$20,377
	Internal Rate of Return		NA	24.8%	24.5%	25.5%	21.0%
Based on National Average Values for Unit Consumption and Energy Price--Relative to Standard 90.1-1999							
	Payback Period (yrs)		NA	4.0	4.1	3.9	4.7
	Cost of Saved Energy ($/MMBtu)		NA	$1.785	$1.808	$1.739	$2.102
	NPV (= LCC Savings) ($)		$0	$14,053	$16,088	$18,494	$20,377
	Internal Rate of Return		NA	24.8%	24.5%	25.5%	21.0%
	Break-even cost multiplier			3.079	3.040	3.160	2.615
		Aggregate Measures					
National Energy Consumption			**Trillion Btu (Primary)**				
2010	4.5	4.5	4.5	4.1	4.1	4.0	3.9
2020	11.4	11.4	11.4	10.5	10.4	10.3	10.0
2030	19.1	19.1	19.1	17.6	17.4	17.2	16.8
Cumulative, 2004-2030	255.9	255.9	255.9	236.2	233.2	230.3	224.7
Emissions				**Million Metric Tons**			
Carbon (MMtons)	3.8	3.8	3.8	3.5	3.5	3.4	3.4
NOX (MMtons)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Discounted LCC for Nation				**Millions of 1998 $**			
from Market Segments	588.0	588.0	588.0	566.8	563.7	560.1	557.3
National NPV							
Relative to EPCA 1992			0.0	21.2	24.3	27.9	30.8
Relative to 90.1-1999				21.2	24.3	27.9	30.8

Quick Calc with National Averages (2010) ***(Note: Energy price fixed at 2010 value)***

	EPCA 1992	Market Baseline	Standard 90.1-1999	TestLevel1	TestLevel2	TestLevel3	MaxAvail
Energy Price ($/MMBtu)	$5.530	$5.530	$5.530	$5.530	$5.530	$5.530	$5.530
Ann. Energy Use (MMBtu)	3,968	3,968	3,968	3,662	3,616	3,571	3,484
Standby Losses (MMBtu)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy cost, $/yr	$21,943	$21,943	$21,943	$20,255	$19,999	$19,749	$19,267
PV (energy cost)	$272,289	$272,289	$272,289	$251,344	$248,162	$245,060	$239,083
Equipment Cost	$22,532	$22,532	$22,532	$29,292	$30,418	$31,094	$35,150
Unit LCC	$294,821	$294,821	$294,821	$280,636	$278,581	$276,155	$274,233
Report created:	3/31/00 11:06 AM						

Product: **Warm Air Furnaces, Gas, 250 kBtu/h**

Output Capacity (Btu/hr)	187,625	Estimated Shipments in 1999	110,644
Lifetime (years)	15	Projected Shipments, 2004-2030	3,550,969
Equip. Price Markup	25%		

Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	TestLevel1	TestLevel2	TestLevel3	MaxAvail
Thermal Efficiency (%)	75.1	75.1	77.5	78.5	79.5	0.0	85.5
Standby Loss (NA)	0	0	0	0	0	0	0
Equip. Price (w/o markup)	$6,072	$6,072	$6,370	$6,533	$6,697	$0	$9,272
Equip. Price (w/ markup)	$7,590	$7,590	$7,962	$8,167	$8,372	$0	$11,590
Year of Standard	NA	NA	2004	2004	2004	2004	2004

LIFE CYCLE COST (LCC) SAVINGS, for 2010 — **1998 Dollars per Unit**

Savings relative to EPCA 1992

	Standard 90.1-1999	TestLevel1	TestLevel2	TestLevel3	MaxAvail
Weighted Average LCC Savings	-$93	-$190	-$291	NA	-$2,931
Max LCC Savings	$629	$810	$982	NA	$0
Min LCC Savings	-$364	-$566	-$768	NA	-$3,970
Percentage of units with LCC savings > 0	24.9%	16.1%	13.5%	0.0%	0.0%

NATIONAL ENERGY SAVINGS — **Trillion Btu (Primary)**

	Standard 90.1-1999	TestLevel1	TestLevel2	TestLevel3	MaxAvail
Relative to EPCA 1992					
2010	5.1	7.1	9.0	NA	19.7
2020	11.7	16.2	20.6	NA	44.8
2030	12.9	17.9	22.8	NA	49.5
2004-2030	236.5	327.6	416.4	NA	905.8
Relative to Standard 90.1-1999					
2010		2.0	3.9	NA	14.5
2020		4.5	8.9	NA	33.1
2030		5.0	9.8	NA	36.6
2004-2030		91.1	180.0	NA	669.3

EMISSIONS REDUCTIONS (2004-2030) — **Million Metric Tons**

	Standard 90.1-1999	TestLevel1	TestLevel2	TestLevel3	MaxAvail
Relative to EPCA 1992					
Carbon Equivalent	3.4	4.8	6.1	NA	13.2
NOx	0.03	0.04	0.04	NA	0.10
Relative to Standard 90.1-1999					
Carbon Equivalent		1.3	2.6	NA	9.8
NOx		0.01	0.02	NA	0.07

NET PRESENT VALUE (NPV) @ Discount Rate of 7.0% — **Million 1998 Dollars**

	Standard 90.1-1999	TestLevel1	TestLevel2	TestLevel3	MaxAvail
Relative to EPCA 1992	-$114.8	-$235.3	-$359.1	NA	-$3,626.4
Relative to Standard 90.1-1999		-$120.5	-$244.3	NA	-$3,511.5

Adjust AEO Fuel Prices: Multiplier: 1.00 Adder ($/MMBtu): $0.000

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Product: **Warm Air Furnaces, Gas, 250 kBtu/h** ***Supplemental Results***

Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	TestLevel1	TestLevel2	TestLevel3	MaxAvail
Thermal Efficiency (%)	75.1	75.1	77.5	78.5	79.5	0.0	85.5
			Key Results: Per Unit Basis				
Input Capacity (MMBtu/hr)	0.250	0.250	0.242	0.239	0.236	NA	0.219
National Ave FLEOH	695.8	695.8	695.8	695.8	695.8	695.8	695.8
Life-Cycle Costs: 1) wgted market segments , 2) w/nat. ave. energy price					2010 Ave. Energy Price=		$5.530
1) Wgted LCC	$16,311	$16,311	$16,404	$16,501	$16,602	NA	$19,242
2) LCC/ave energy price	$16,296	$16,296	$16,390	$16,487	$16,588	NA	$19,230
Measures of Investment Performance For Efficiency Levels Exceeding EPCA 1992 (for Year 2010)							
Based on National Average Values for Unit Consumption and Energy Price--Relative to EPCA 1992							
Payback Period (yrs)			12.1	13.5	14.4	NA	33.9
Cost of Saved Energy ($/MMBtu)			$7.338	$8.216	$8.760	NA	$20.604
NPV (= LCC Savings) ($)			-$93	-$191	-$291	NA	-$2,933
Internal Rate of Return			2.7%	1.2%	0.4%	NA	-8.9%
Based on National Average Values for Unit Consumption and Energy Price--Relative to Standard 90.1-1999							
Payback Period (yrs)			NA	17.3	17.5	NA	41.7
Cost of Saved Energy ($/MMBtu)			NA	$10.493	$10.627	NA	$25.291
NPV (= LCC Savings) ($)			$0	-$98	-$198	NA	-$2,840
Internal Rate of Return			NA	-1.8%	-2.0%	NA	NA
Break-even cost multiplier				0.524	0.517	NA	0.217
			Aggregate Measures				
National Energy Consumption			**Trillion Btu (Primary)**				
2010	160.6	160.6	155.4	153.4	151.5	NA	140.9
2020	365.6	365.6	353.9	349.4	345.0	NA	320.8
2030	404.0	404.0	391.0	386.1	381.2	NA	354.5
Cumulative, 2004-2030	7,392.4	7,392.4	7,156.0	7,064.9	6,976.0	NA	6,486.6
Emissions				**Million Metric Tons**			
Carbon (MMtons)	110.9	110.9	107.4	106.1	104.8	NA	97.7
NOX (MMtons)	0.8	0.8	0.8	0.8	0.8	NA	0.7
Discounted LCC for Nation				**Millions of 1998 $**			
from Market Segments	26,828.9	26,828.9	26,943.8	27,064.2	27,188.1	NA	30,455.3
National NPV							
Relative to EPCA 1992			-114.8	-235.3	-359.1	NA	-3,626.4
Relative to 90.1-1999				-120.5	-244.3	NA	-3,511.5

Quick Calc with National Averages (2010) ***(Note: Energy price fixed at 2010 value)***

	EPCA 1992	Market Baseline	Standard 90.1-1999	TestLevel1	TestLevel2	TestLevel3	MaxAvail
Energy Price ($/MMBtu)	$5.530	$5.530	$5.530	$5.530	$5.530	$5.530	$5.530
Ann. Energy Use (MMBtu)	174	174	168	166	164	NA	153
Standby Losses (MMBtu)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy cost, $/yr	$962	$962	$931	$919	$908	NA	$844
PV (energy cost)	$8,762	$8,762	$8,482	$8,374	$8,269	NA	$7,689
Equipment Cost	$7,590	$7,590	$7,962	$8,167	$8,372	$0	$11,590
Unit LCC	$16,352	$16,352	$16,444	$16,541	$16,640	NA	$19,278
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Product: **Warm Air Furnaces, Gas, 400 kBtu/h**

Output Capacity (Btu/hr)	300,200	Estimated Shipments in 1999	70,740
Lifetime (years)	15	Projected Shipments, 2004-2030	2,270,292
Equip. Price Markup	25%		

Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	TestLevel1	TestLevel2	TestLevel3	MaxAvail
Thermal Efficiency (%)	75.1	75.1	77.5	78.5	79.5	0.0	85.5
Standby Loss (NA)	0	0	0	0	0	0	0
Equip. Price (w/o markup)	$9,427	$9,427	$9,521	$9,729	$9,936	$0	$14,122
Equip. Price (w/ markup)	$11,784	$11,784	$11,902	$12,161	$12,420	$0	$17,652
Year of Standard	NA	NA	2004	2004	2004	2004	2004
LIFE CYCLE COST (LCC) SAVINGS, for 2010				**1998 Dollars per Unit**			
Savings relative to EPCA 1992							
Weighted Average LCC Savings			$329	$241	$150	NA	-$4,159
Max LCC Savings			$1,484	$1,842	$2,185	NA	$269
Min LCC Savings			-$105	-$360	-$614	NA	-$5,821
Percentage of units with LCC savings > 0			89.5%	69.8%	63.1%	0.0%	0.1%
NATIONAL ENERGY SAVINGS				**Trillion Btu (Primary)**			
Relative to EPCA 1992							
2010			5.3	7.3	9.3	NA	20.1
2020			12.0	16.6	21.1	NA	45.8
2030			13.2	18.3	23.3	NA	50.6
2004-2030			241.9	335.1	426.0	NA	926.6
Relative to Standard 90.1-1999							
2010				2.0	4.0	NA	14.9
2020				4.6	9.1	NA	33.9
2030				5.1	10.1	NA	37.4
2004-2030				93.2	184.1	NA	684.7
EMISSIONS REDUCTIONS (2004-2030)				**Million Metric Tons**			
Relative to EPCA 1992							
Carbon Equivalent			3.5	4.9	6.2	NA	13.5
NOx			0.03	0.04	0.05	NA	0.10
Relative to Standard 90.1-1999							
Carbon Equivalent				1.4	2.7	NA	10.0
NOx				0.01	0.02	NA	0.07
NET PRESENT VALUE (NPV) @ Discount Rate of		7.0%		**Million 1998 Dollars**			
Relative to EPCA 1992			$260.1	$191.1	$118.8	NA	-$3,289.1
Relative to Standard 90.1-1999				-$68.9	-$141.3	NA	-$3,549.1

Adjust AEO Fuel Prices:	Multiplier:	1.00	Adder ($/MMBtu):	$0.000
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Product:	**Warm Air Furnaces, Gas, 400 kBtu/h**				***Supplemental Results***		
Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	TestLevel1	TestLevel2	TestLevel3	MaxAvail
Thermal Efficiency (%)	75.1	75.1	77.5	78.5	79.5	0.0	85.5
		Key Results: Per Unit Basis					
Input Capacity (MMBtu/hr)	0.400	0.400	0.387	0.382	0.377	NA	0.351
National Ave FLEOH	695.8	695.8	695.8	695.8	695.8	695.8	695.8
Life-Cycle Costs: 1) wgted market segments , 2) w/nat. ave. energy price					2010 Ave. Energy Price=		$5.530
1) Wgted LCC	$25,737	$25,737	$25,409	$25,496	$25,588	NA	$29,896
2) LCC/ave energy price	$25,714	$25,714	$25,386	$25,474	$25,566	NA	$29,875
Measures of Investment Performance For Efficiency Levels Exceeding EPCA 1992 (for Year 2010)							
Based on National Average Values for Unit Consumption and Energy Price--Relative to EPCA 1992							
Payback Period (yrs)			2.4	5.5	7.3	NA	31.1
Cost of Saved Energy ($/MMBtu)			$1.453	$3.357	$4.456	NA	$18.893
NPV (= LCC Savings) ($)			$328	$240	$148	NA	-$4,161
Internal Rate of Return			41.4%	16.1%	10.5%	NA	-8.1%
Based on National Average Values for Unit Consumption and Energy Price--Relative to Standard 90.1-1999							
Payback Period (yrs)			NA	13.7	13.8	NA	41.3
Cost of Saved Energy ($/MMBtu)			NA	$8.296	$8.402	NA	$25.054
NPV (= LCC Savings) ($)			$0	-$88	-$179	NA	-$4,489
Internal Rate of Return			NA	1.1%	0.9%	NA	NA
Break-even cost multiplier				0.662	0.654	NA	0.219
		Aggregate Measures					
National Energy Consumption			**Trillion Btu (Primary)**				
2010	164.2	164.2	159.0	157.0	155.0	NA	144.1
2020	374.0	374.0	362.1	357.5	353.0	NA	328.2
2030	413.2	413.2	400.0	394.9	390.0	NA	362.6
Cumulative, 2004-2030	7,562.1	7,562.1	7,320.2	7,227.0	7,136.1	NA	6,635.5
Emissions				**Million Metric Tons**			
Carbon (MMtons)	113.4	113.4	109.9	108.5	107.2	NA	99.9
NOX (MMtons)	0.8	0.8	0.8	0.8	0.8	NA	0.7
Discounted LCC for Nation				**Millions of 1998 $**			
from Market Segments	27,066.0	27,066.0	26,805.9	26,874.9	26,947.3	NA	30,355.1
National NPV							
Relative to EPCA 1992			260.1	191.1	118.8	NA	-3,289.1
Relative to 90.1-1999				-68.9	-141.3	NA	-3,549.1

Quick Calc with National Averages (2010) ***(Note: Energy price fixed at 2010 value)***

	EPCA 1992	Market Baseline	Standard 90.1-1999	TestLevel1	TestLevel2	TestLevel3	MaxAvail
Energy Price ($/MMBtu)	$5.530	$5.530	$5.530	$5.530	$5.530	$5.530	$5.530
Ann. Energy Use (MMBtu)	278	278	269	266	263	NA	244
Standby Losses (MMBtu)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy cost, $/yr	$1,539	$1,539	$1,490	$1,471	$1,453	NA	$1,351
PV (energy cost)	$14,019	$14,019	$13,571	$13,398	$13,230	NA	$12,302
Equipment Cost	$11,784	$11,784	$11,902	$12,161	$12,420	$0	$17,652
Unit LCC	$25,803	$25,803	$25,473	$25,559	$25,650	NA	$29,954
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Product:	Storage Water Heater, Gas, 120 kBtu/h						
Output Capacity (Btu/hr)	93,600			Estimated Shipments in 1999			21,083
Lifetime (years)	7			Projected Shipments, 2004-2030			676,629
Equip. Price Markup	25%						

Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	Test Level 1	TestLevel2	TestLevel3	MaxAvail
Thermal Efficiency (%)	78.0	78.0	80.0	82.0	82.0	86.0	94.0
Standby Loss (Btu/hr)	1193	1193	1103	1103	1053	804	804
Equip. Price (w/o markup)	$1,775	$1,775	$1,822	$1,869	$1,897	$2,787	$3,739
Equip. Price (w/ markup)	$2,219	$2,219	$2,277	$2,337	$2,371	$3,483	$4,673
Year of Standard	NA	NA	2004	2004	2004	2004	2004

LIFE CYCLE COST (LCC) SAVINGS, for 2010		1998 Dollars per Unit				
Savings relative to EPCA 1992						
Weighted Average LCC Savings		$23	$20	-$2	-$950	-$1,956
Max LCC Savings		$88	$145	$124	$0	$0
Min LCC Savings		-$12	-$47	-$70	-$1,081	-$2,190
Percentage of units with LCC savings > 0		53.5%	50.7%	43.5%	0.0%	0.0%

NATIONAL ENERGY SAVINGS	Trillion Btu (Primary)				
Relative to EPCA 1992					
2010	0.5	0.8	0.9	1.8	2.9
2020	0.5	0.9	1.0	2.0	3.2
2030	0.6	1.0	1.1	2.3	3.6
2004-2030	12.4	21.1	22.9	48.3	76.3
Relative to Standard 90.1-1999					
2010		0.3	0.4	1.4	2.4
2020		0.4	0.4	1.5	2.7
2030		0.4	0.5	1.7	3.0
2004-2030		8.6	10.5	35.9	63.9

EMISSIONS REDUCTIONS (2004-2030)	Million Metric Tons				
Relative to EPCA 1992					
Carbon Equivalent	0.2	0.3	0.3	0.7	1.1
NOx	0.00	0.00	0.00	0.01	0.01
Relative to Standard 90.1-1999					
Carbon Equivalent		0.1	0.2	0.5	0.9
NOx		0.00	0.00	0.00	0.01

NET PRESENT VALUE (NPV) @ Discount Rate of	7.0%	Million 1998 Dollars				
Relative to EPCA 1992		$5.3	$4.6	-$0.6	-$223.9	-$461.3
Relative to Standard 90.1-1999			-$0.7	-$5.9	-$229.3	-$466.6

Adjust AEO Fuel Prices:	Multiplier:	1.00	Adder ($/MMBtu):	$0.000
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Product:	Storage Water Heater, Gas, 120 kBtu/h				Supplemental Results		
Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	Test Level 1	TestLevel2	TestLevel3	MaxAvail
Thermal Efficiency (%)	78.0	78.0	80.0	82.0	82.0	86.0	94.0
			Key Results: Per Unit Basis				
Input Capacity (MMBtu/hr)	0.120	0.120	0.117	0.114	0.114	0.109	0.100
National Ave FLEOH	656.2	656.2	656.2	656.2	656.2	656.2	656.2
Life-Cycle Costs: 1) wgted market segments , 2) w/nat. ave. energy price					2010 Ave. Energy Price=		$5.530
1) Wgted LCC	$4,881	$4,881	$4,858	$4,861	$4,883	$5,831	$6,837
2) LCC/ave energy price	$4,841	$4,841	$4,819	$4,823	$4,845	$5,794	$6,804
Measures of Investment Performance For Efficiency Levels Exceeding EPCA 1992 (for Year 2010)							
Based on National Average Values for Unit Consumption and Energy Price--Relative to EPCA 1992							
	Payback Period (yrs)		3.9	4.7	5.5	21.8	26.8
	Cost of Saved Energy ($/MMBtu)		$4.023	$4.784	$5.675	$22.389	$27.503
	NPV (= LCC Savings) ($)		$22	$18	-$5	-$954	-$1,963
	Internal Rate of Return		16.9%	11.2%	6.1%	NA	NA
Based on National Average Values for Unit Consumption and Energy Price--Relative to Standard 90.1-1999							
	Payback Period (yrs)		NA	5.7	7.4	28.0	31.3
	Cost of Saved Energy ($/MMBtu)		NA	$5.881	$7.631	$28.756	$32.073
	NPV (= LCC Savings) ($)		$0	-$4	-$26	-$975	-$1,985
	Internal Rate of Return		NA	5.1%	-1.6%	NA	NA
	Break-even cost multiplier			0.936	0.721	0.191	0.172
			Aggregate Measures				
National Energy Consumption			**Trillion Btu (Primary)**				
2010	15.5	15.5	15.1	14.7	14.7	13.7	12.6
2020	17.2	17.2	16.7	16.3	16.2	15.1	14.0
2030	19.0	19.0	18.4	18.0	17.9	16.7	15.4
Cumulative, 2004-2030	407.6	407.6	395.2	386.5	384.6	359.3	331.2
Emissions				**Million Metric Tons**			
Carbon (MMtons)	6.3	6.3	6.1	6.0	6.0	5.6	5.2
NOX (MMtons)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Discounted LCC for Nation				**Millions of 1998 $**			
from Market Segments	1,528.5	1,528.5	1,523.2	1,523.9	1,529.1	1,752.5	1,989.8
National NPV							
Relative to EPCA 1992			5.3	4.6	-0.6	-223.9	-461.3
Relative to 90.1-1999				-0.7	-5.9	-229.3	-466.6

Quick Calc with National Averages (2010) ***(Note: Energy price fixed at 2010 value)***

	EPCA 1992	Market Baseline	Standard 90.1-1999	Test Level 1	TestLevel2	TestLevel3	MaxAvail
Energy Price ($/MMBtu)	$5.530	$5.530	$5.530	$5.530	$5.530	$5.530	$5.530
Ann. Energy Use (MMBtu)	79	79	77	75	75	71	65
Standby Losses (MMBtu)	9.7	9.7	8.9	8.9	8.5	6.5	6.5
Energy cost, $/yr	$489	$489	$474	$464	$461	$431	$397
PV (energy cost)	$2,635	$2,635	$2,555	$2,499	$2,487	$2,323	$2,142
Equipment Cost	$2,219	$2,219	$2,277	$2,337	$2,371	$3,483	$4,673
Unit LCC	$4,854	$4,854	$4,832	$4,836	$4,858	$5,806	$6,815
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Product: **Storage Water Heater, Gas, 199 kBtu/h**

Output Capacity (Btu/hr)	155,220	Estimated Shipments in 1999	42,166
Lifetime (years)	7	Projected Shipments, 2004-2030	1,353,258
Equip. Price Markup	25%		

Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	Test Level 1	TestLevel2	TestLevel3	MaxAvail
Thermal Efficiency (%)	78.0	78.0	80.0	82.0	82.0	86.0	94.0
Standby Loss (Btu/hr)	1262	1262	1349	1349	1291	934	934
Equip. Price (w/o markup)	$2,213	$2,213	$2,291	$2,369	$2,401	$3,696	$4,739
Equip. Price (w/ markup)	$2,766	$2,766	$2,863	$2,962	$3,002	$4,620	$5,923
Year of Standard	NA	NA	2004	2004	2004	2004	2004
LIFE CYCLE COST (LCC) SAVINGS, for 2010				**1998 Dollars per Unit**			
Savings relative to EPCA 1992							
Weighted Average LCC Savings			-$21	-$27	-$53	-$1,413	-$2,417
Max LCC Savings			$77	$168	$144	$0	$0
Min LCC Savings			-$74	-$131	-$159	-$1,621	-$2,793
Percentage of units with LCC savings > 0			42.6%	42.6%	42.6%	0.0%	0.0%
NATIONAL ENERGY SAVINGS				**Trillion Btu (Primary)**			
Relative to EPCA 1992							
2010			0.9	2.0	2.1	5.2	8.6
2020			1.0	2.2	2.4	5.7	9.6
2030			1.1	2.4	2.6	6.3	10.6
2004-2030			23.2	51.4	55.8	135.0	226.7
Relative to Standard 90.1-1999							
2010				1.1	1.2	4.3	7.8
2020				1.2	1.4	4.7	8.6
2030				1.3	1.5	5.2	9.5
2004-2030				28.2	32.6	111.8	203.5
EMISSIONS REDUCTIONS (2004-2030)				**Million Metric Tons**			
Relative to EPCA 1992							
Carbon Equivalent			0.3	0.8	0.8	2.0	3.3
NOx			0.00	0.01	0.01	0.01	0.02
Relative to Standard 90.1-1999							
Carbon Equivalent				0.4	0.5	1.6	3.0
NOx				0.00	0.00	0.01	0.02
NET PRESENT VALUE (NPV) @ Discount Rate of		7.0%		**Million 1998 Dollars**			
Relative to EPCA 1992			-$10.0	-$12.9	-$25.1	-$666.3	-$1,139.9
Relative to Standard 90.1-1999				-$2.9	-$15.1	-$656.4	-$1,130.0

Adjust AEO Fuel Prices:	Multiplier:	1.00	Adder ($/MMBtu):	$0.000
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Product:	Storage Water Heater, Gas, 199 kBtu/h				*Supplemental Results*		
Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	Test Level 1	TestLevel2	TestLevel3	MaxAvail
Thermal Efficiency (%)	78.0	78.0	80.0	82.0	82.0	86.0	94.0
Key Results: Per Unit Basis							
Input Capacity (MMBtu/hr)	0.199	0.199	0.194	0.189	0.189	0.180	0.165
National Ave FLEOH	647.2	647.2	647.2	647.2	647.2	647.2	647.2
Life-Cycle Costs: 1) wgted market segments , 2) w/nat. ave. energy price					2010 Ave. Energy Price=		$5.530
1) Wgted LCC	$6,954	$6,954	$6,975	$6,981	$7,007	$8,366	$9,370
2) LCC/ave energy price	$6,889	$6,889	$6,911	$6,919	$6,945	$8,308	$9,317
Measures of Investment Performance For Efficiency Levels Exceeding EPCA 1992 (for Year 2010)							
Based on National Average Values for Unit Consumption and Energy Price--Relative to EPCA 1992							
Payback Period (yrs)			7.0	6.3	7.0	22.9	23.2
Cost of Saved Energy ($/MMBtu)			$7.161	$6.503	$7.223	$23.485	$23.829
NPV (= LCC Savings) ($)			-$22	-$30	-$56	-$1,419	-$2,428
Internal Rate of Return			-0.1%	2.4%	-0.3%	NA	NA
Based on National Average Values for Unit Consumption and Energy Price--Relative to Standard 90.1-1999							
Payback Period (yrs)			NA	5.8	7.1	26.2	25.1
Cost of Saved Energy ($/MMBtu)			NA	$5.962	$7.268	$26.869	$25.727
NPV (= LCC Savings) ($)			$0	-$8	-$34	-$1,397	-$2,406
Internal Rate of Return			NA	4.7%	-0.4%	NA	NA
Break-even cost multiplier				0.923	0.757	0.205	0.214
Aggregate Measures							
National Energy Consumption			**Trillion Btu (Primary)**				
2010	48.9	48.9	48.0	46.9	46.8	43.8	40.3
2020	54.1	54.1	53.1	51.9	51.7	48.4	44.5
2030	59.7	59.7	58.6	57.3	57.1	53.4	49.2
Cumulative, 2004-2030	1,281.8	1,281.8	1,258.7	1,230.4	1,226.1	1,146.8	1,055.2
Emissions				**Million Metric Tons**			
Carbon (MMtons)	19.8	19.8	19.5	19.1	19.0	17.8	16.5
NOX (MMtons)	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Discounted LCC for Nation			**Millions of 1998 $**				
from Market Segments	4,355.0	4,355.0	4,364.9	4,367.9	4,380.1	5,021.3	5,494.9
National NPV							
Relative to EPCA 1992			-10.0	-12.9	-25.1	-666.3	-1,139.9
Relative to 90.1-1999				-2.9	-15.1	-656.4	-1,130.0

Quick Calc with National Averages (2010) ***(Note: Energy price fixed at 2010 value)***

	EPCA 1992	Market Baseline	Standard 90.1-1999	Test Level 1	TestLevel2	TestLevel3	MaxAvail
Energy Price ($/MMBtu)	$5.530	$5.530	$5.530	$5.530	$5.530	$5.530	$5.530
Ann. Energy Use (MMBtu)	129	129	126	123	123	117	107
Standby Losses (MMBtu)	10.2	10.2	10.9	10.9	10.5	7.6	7.6
Energy cost, $/yr	$769	$769	$755	$738	$735	$688	$633
PV (energy cost)	$4,144	$4,144	$4,069	$3,977	$3,963	$3,707	$3,411
Equipment Cost	$2,766	$2,766	$2,863	$2,962	$3,002	$4,620	$5,923
Unit LCC	$6,910	$6,910	$6,932	$6,939	$6,965	$8,327	$9,334
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Product:	**Storage Water Heater, Gas, 360 kBtu/h**						
Output Capacity (Btu/hr)	280,800			Estimated Shipments in 1999			42,166
Lifetime (years)	7			Projected Shipments, 2004-2030			1,353,258
Equip. Price Markup	25%						
Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	Test Level 1	TestLevel2	TestLevel3	MaxAvail
Thermal Efficiency (%)	78.0	78.0	80.0	82.0	82.0	86.0	94.0
Standby Loss (Btu/hr)	1262	1262	1550	1550	1492	934	934
Equip. Price (w/o markup)	$3,784	$3,784	$3,924	$4,067	$4,099	$6,319	$8,134
Equip. Price (w/ markup)	$4,730	$4,730	$4,906	$5,084	$5,124	$7,899	$10,167
Year of Standard	NA	NA	2004	2004	2004	2004	2004
LIFE CYCLE COST (LCC) SAVINGS, for 2010				**1998 Dollars per Unit**			
Savings relative to EPCA 1992							
Weighted Average LCC Savings			-$74	-$90	-$116	-$2,453	-$4,193
Max LCC Savings			$93	$248	$224	$0	$0
Min LCC Savings			-$164	-$271	-$298	-$2,815	-$4,850
Percentage of units with LCC savings > 0			38.5%	42.4%	40.8%	0.0%	0.0%
NATIONAL ENERGY SAVINGS				**Trillion Btu (Primary)**			
Relative to EPCA 1992							
2010			1.2	3.1	3.2	8.4	14.5
2020			1.3	3.4	3.6	9.2	16.1
2030			1.4	3.8	4.0	10.2	17.7
2004-2030			30.7	80.5	84.9	219.3	380.9
Relative to Standard 90.1-1999							
2010				1.9	2.1	7.2	13.4
2020				2.1	2.3	8.0	14.8
2030				2.3	2.5	8.8	16.3
2004-2030				49.8	54.1	188.6	350.2
EMISSIONS REDUCTIONS (2004-2030)				**Million Metric Tons**			
Relative to EPCA 1992							
Carbon Equivalent			0.5	1.2	1.2	3.2	5.6
NOx			0.00	0.01	0.01	0.02	0.04
Relative to Standard 90.1-1999							
Carbon Equivalent				0.7	0.8	2.8	5.1
NOx				0.01	0.01	0.02	0.04
NET PRESENT VALUE (NPV) @ Discount Rate of		7.0%		**Million 1998 Dollars**			
Relative to EPCA 1992			-$35.1	-$42.4	-$54.7	-$1,156.9	-$1,977.5
Relative to Standard 90.1-1999				-$7.3	-$19.5	-$1,121.8	-$1,942.4
Adjust AEO Fuel Prices:	Multiplier:	1.00	Adder ($/MMBtu):		$0.000		
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Product:	**Storage Water Heater, Gas, 360 kBtu/h**				***Supplemental Results***		
Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	Test Level 1	TestLevel2	TestLevel3	MaxAvail
Thermal Efficiency (%)	78.0	78.0	80.0	82.0	82.0	86.0	94.0
		Key Results: Per Unit Basis					
Input Capacity (MMBtu/hr)	0.360	0.360	0.351	0.342	0.342	0.327	0.299
National Ave FLEOH	630.7	630.7	630.7	630.7	630.7	630.7	630.7
Life-Cycle Costs: 1) wgted market segments , 2) w/nat. ave. energy price					2010 Ave. Energy Price=		$5.530
1) Wgted LCC	$11,879	$11,879	$11,954	$11,969	$11,995	$14,332	$16,072
2) LCC/ave energy price	$11,767	$11,767	$11,844	$11,862	$11,888	$14,231	$15,979
Measures of Investment Performance For Efficiency Levels Exceeding EPCA 1992 (for Year 2010)							
Based on National Average Values for Unit Consumption and Energy Price--Relative to EPCA 1992							
Payback Period (yrs)			9.5	7.3	7.7	24.1	23.8
Cost of Saved Energy ($/MMBtu)			$9.765	$7.511	$7.933	$24.719	$24.419
NPV (= LCC Savings) ($)			-$77	-$95	-$121	-$2,464	-$4,212
Internal Rate of Return			-7.3%	-1.2%	-2.6%	NA	NA
Based on National Average Values for Unit Consumption and Energy Price--Relative to Standard 90.1-1999							
Payback Period (yrs)			NA	6.0	6.7	26.5	25.0
Cost of Saved Energy ($/MMBtu)			NA	$6.118	$6.893	$27.157	$25.706
NPV (= LCC Savings) ($)			$0	-$18	-$44	-$2,387	-$4,135
Internal Rate of Return			NA	4.0%	0.9%	NA	NA
Break-even cost multiplier				0.899	0.798	0.203	0.214
		Aggregate Measures					
National Energy Consumption			**Trillion Btu (Primary)**				
2010	83.5	83.5	82.3	80.4	80.2	75.1	68.9
2020	92.3	92.3	91.0	88.9	88.7	83.0	76.2
2030	101.9	101.9	100.5	98.2	98.0	91.7	84.2
Cumulative, 2004-2030	2,188.0	2,188.0	2,157.3	2,107.5	2,103.1	1,968.7	1,807.1
Emissions				**Million Metric Tons**			
Carbon (MMtons)	33.8	33.8	33.4	32.6	32.6	30.6	28.2
NOX (MMtons)	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Discounted LCC for Nation				**Millions of 1998 $**			
from Market Segments	7,439.7	7,439.7	7,474.8	7,482.1	7,494.3	8,596.6	9,417.2
National NPV							
Relative to EPCA 1992			-35.1	-42.4	-54.7	-1,156.9	-1,977.5
Relative to 90.1-1999				-7.3	-19.5	-1,121.8	-1,942.4

Quick Calc with National Averages (2010) ***(Note: Energy price fixed at 2010 value)***

	EPCA 1992	Market Baseline	Standard 90.1-1999	Test Level 1	TestLevel2	TestLevel3	MaxAvail
Energy Price ($/MMBtu)	$5.530	$5.530	$5.530	$5.530	$5.530	$5.530	$5.530
Ann. Energy Use (MMBtu)	227	227	221	216	216	206	188
Standby Losses (MMBtu)	10.3	10.3	12.6	12.6	12.1	7.6	7.6
Energy cost, $/yr	$1,312	$1,312	$1,294	$1,264	$1,262	$1,181	$1,084
PV (energy cost)	$7,073	$7,073	$6,974	$6,813	$6,799	$6,364	$5,842
Equipment Cost	$4,730	$4,730	$4,906	$5,084	$5,124	$7,899	$10,167
Unit LCC	$11,803	$11,803	$11,879	$11,896	$11,922	$14,263	$16,009
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Product:	**Instantaneous Water Heater, Gas, 400 kBtu/h**						
Output Capacity (Btu/hr)	320,000			Estimated Shipments in 1999			30,199
Lifetime (years)	15			Projected Shipments, 2004-2030			969,194
Equip. Price Markup	25%						
Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	Test Level 1	TestLevel2	TestLevel3	MaxAvail
Thermal Efficiency (%)	80.0	80.0	80.0	83.0	NA	86.0	94.0
Standby Loss (Btu/hr)	0	0	0	0	0	0	0
Equip. Price (w/o markup)	$2,794	$2,794	$2,794	$3,420	$0	$4,991	$6,839
Equip. Price (w/ markup)	$3,492	$3,492	$3,492	$4,274	$0	$6,238	$8,549
Year of Standard	NA	NA	2004	2004	2004	2004	2004
LIFE CYCLE COST (LCC) SAVINGS, for 2010				**1998 Dollars per Unit**			
Savings relative to EPCA 1992							
Weighted Average LCC Savings			$0	-$335	NA	-$1,883	-$3,215
Max LCC Savings			$0	$131	NA	$0	$0
Min LCC Savings			$0	-$582	NA	-$2,360	-$4,232
Percentage of units with LCC savings > 0			100.0%	11.1%	0.0%	0.0%	0.0%
NATIONAL ENERGY SAVINGS				**Trillion Btu (Primary)**			
Relative to EPCA 1992							
2010			0.0	2.2	NA	4.3	9.1
2020			0.0	5.0	NA	9.7	20.8
2030			0.0	5.6	NA	10.8	23.0
2004-2030			0.0	102.0	NA	196.9	420.4
Relative to Standard 90.1-1999							
2010				2.2	NA	4.3	9.1
2020				5.0	NA	9.7	20.8
2030				5.6	NA	10.8	23.0
2004-2030				102.0	NA	196.9	420.4
EMISSIONS REDUCTIONS (2004-2030)				**Million Metric Tons**			
Relative to EPCA 1992							
Carbon Equivalent			0.0	1.5	NA	2.9	6.1
NOx			0.00	0.01	NA	0.02	0.05
Relative to Standard 90.1-1999							
Carbon Equivalent				1.5	NA	2.9	6.1
NOx				0.01	NA	0.02	0.05
NET PRESENT VALUE (NPV) @ Discount Rate of		7.0%		**Million 1998 Dollars**			
Relative to EPCA 1992			$0.0	-$113.2	NA	-$636.0	-$1,085.7
Relative to Standard 90.1-1999				-$113.2	NA	-$636.0	-$1,085.7
Adjust AEO Fuel Prices:	Multiplier:	1.00	Adder ($/MMBtu):	$0.000			
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Product:	Instantaneous Water Heater, Gas, 400 kBtu/h				*Supplemental Results*		
Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	Test Level 1	TestLevel2	TestLevel3	MaxAvail
Thermal Efficiency (%)	80.0	80.0	80.0	83.0	NA	86.0	94.0
		Key Results: Per Unit Basis					
Input Capacity (MMBtu/hr)	0.400	0.400	0.400	0.386	NA	0.372	0.340
National Ave FLEOH	608.3	608.3	608.3	608.3	608.3	608.3	608.3
Life-Cycle Costs: 1) wgted market segments , 2) w/nat. ave. energy price					2010 Ave. Energy Price=		$5.530
1) Wgted LCC	$15,857	$15,857	$15,857	$16,192	NA	$17,741	$19,072
2) LCC/ave energy price	$15,671	$15,671	$15,671	$16,013	NA	$17,567	$18,914
Measures of Investment Performance For Efficiency Levels Exceeding EPCA 1992 (for Year 2010)							
Based on National Average Values for Unit Consumption and Energy Price--Relative to EPCA 1992							
Payback Period (yrs)			NA	16.1	NA	29.2	25.2
Cost of Saved Energy ($/MMBtu)			NA	$9.762	NA	$17.759	$15.319
NPV (= LCC Savings) ($)			$0	-$342	NA	-$1,896	-$3,243
Internal Rate of Return			NA	-0.9%	NA	-7.5%	-6.0%
Based on National Average Values for Unit Consumption and Energy Price--Relative to Standard 90.1-1999							
Payback Period (yrs)			NA	16.1	NA	29.2	25.2
Cost of Saved Energy ($/MMBtu)			NA	$9.762	NA	$17.759	$15.319
NPV (= LCC Savings) ($)			$0	-$342	NA	-$1,896	-$3,243
Internal Rate of Return			NA	-0.9%	NA	-7.5%	-6.0%
Break-even cost multiplier				0.563	NA	0.309	0.359
		Aggregate Measures					
National Energy Consumption			**Trillion Btu (Primary)**				
2010	61.3	61.3	61.3	59.1	NA	57.0	52.2
2020	139.6	139.6	139.6	134.6	NA	129.9	118.8
2030	154.2	154.2	154.2	148.7	NA	143.5	131.3
Cumulative, 2004-2030	2,822.4	2,822.4	2,822.4	2,720.4	NA	2,625.5	2,402.0
Emissions			**Million Metric Tons**				
Carbon (MMtons)	42.3	42.3	42.3	40.8	NA	39.5	36.2
NOX (MMtons)	0.3	0.3	0.3	0.3	NA	0.3	0.3
Discounted LCC for Nation			**Millions of 1998 $**				
from Market Segments	7,120.5	7,120.5	7,120.5	7,233.6	NA	7,756.4	8,206.2
National NPV							
Relative to EPCA 1992			0.0	-113.2	NA	-636.0	-1,085.7
Relative to 90.1-1999				-113.2	NA	-636.0	-1,085.7

Quick Calc with National Averages (2010) ***(Note: Energy price fixed at 2010 value)***

Energy Price ($/MMBtu)	$5.530	$5.530	$5.530	$5.530	$5.530	$5.530	$5.530
Ann. Energy Use (MMBtu)	243	243	243	235	NA	226	207
Standby Losses (MMBtu)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy cost, $/yr	$1,346	$1,346	$1,346	$1,297	NA	$1,252	$1,145
PV (energy cost)	$12,257	$12,257	$12,257	$11,814	NA	$11,402	$10,431
Equipment Cost	$3,492	$3,492	$3,492	$4,274	$0	$6,238	$8,549
Unit LCC	$15,749	$15,749	$15,749	$16,088	NA	$17,640	$18,980
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Product:	Instantaneous Water Heater, Gas, 1000 kBtu/h					

Output Capacity (Btu/hr)	800,000	Estimated Shipments in 1999	12,079
Lifetime (years)	15	Projected Shipments, 2004-2030	387,658
Equip. Price Markup	25%		

Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	Test Level 1	TestLevel2	TestLevel3	MaxAvail
Thermal Efficiency (%)	80.0	80.0	80.0	83.0	NA	86.0	94.0
Standby Loss (Btu/hr)	0	0	0	0	0	0	0
Equip. Price (w/o markup)	$4,294	$4,294	$4,294	$4,920	$0	$6,491	$9,839
Equip. Price (w/ markup)	$5,368	$5,368	$5,368	$6,150	$0	$8,113	$12,299
Year of Standard	NA	NA	2004	2004	2004	2004	2004

	Standard 90.1-1999	Test Level 1	TestLevel2	TestLevel3	MaxAvail
LIFE CYCLE COST (LCC) SAVINGS, for 2010	**1998 Dollars per Unit**				
Savings relative to EPCA 1992					
Weighted Average LCC Savings	$0	$335	NA	-$589	-$2,328
Max LCC Savings	$0	$1,500	NA	$1,659	$2,472
Min LCC Savings	$0	-$282	NA	-$1,780	-$4,870
Percentage of units with LCC savings > 0	100.0%	50.3%	0.0%	41.9%	29.8%
NATIONAL ENERGY SAVINGS	**Trillion Btu (Primary)**				
Relative to EPCA 1992					
2010	0.0	2.2	NA	4.3	9.1
2020	0.0	5.0	NA	9.7	20.8
2030	0.0	5.6	NA	10.8	23.0
2004-2030	0.0	102.0	NA	196.9	420.3
Relative to Standard 90.1-1999					
2010		2.2	NA	4.3	9.1
2020		5.0	NA	9.7	20.8
2030		5.6	NA	10.8	23.0
2004-2030		102.0	NA	196.9	420.3
EMISSIONS REDUCTIONS (2004-2030)	**Million Metric Tons**				
Relative to EPCA 1992					
Carbon Equivalent	0.0	1.5	NA	2.9	6.1
NOx	0.00	0.01	NA	0.02	0.05
Relative to Standard 90.1-1999					
Carbon Equivalent		1.5	NA	2.9	6.1
NOx		0.01	NA	0.02	0.05
NET PRESENT VALUE (NPV) @ Discount Rate of 7.0%	**Million 1998 Dollars**				
Relative to EPCA 1992	$0.0	$45.3	NA	-$79.6	-$314.4
Relative to Standard 90.1-1999		$45.3	NA	-$79.6	-$314.4

Adjust AEO Fuel Prices:	Multiplier:	1.00	Adder ($/MMBtu):	$0.000
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Product:	**Instantaneous Water Heater, Gas, 1000 kBtu/h**				***Supplemental Results***		
Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	Test Level 1	TestLevel2	TestLevel3	MaxAvail
Thermal Efficiency (%)	80.0	80.0	80.0	83.0	NA	86.0	94.0
			Key Results: Per Unit Basis				
Input Capacity (MMBtu/hr)	1.000	1.000	1.000	0.964	NA	0.930	0.851
National Ave FLEOH	608.3	608.3	608.3	608.3	608.3	608.3	608.3
Life-Cycle Costs: 1) wgted market segments , 2) w/nat. ave. energy price					2010 Ave. Energy Price=		$5.530
1) Wgted LCC	$36,280	$36,280	$36,280	$35,945	NA	$36,869	$38,607
2) LCC/ave energy price	$35,814	$35,814	$35,814	$35,496	NA	$36,436	$38,211
Measures of Investment Performance For Efficiency Levels Exceeding EPCA 1992 (for Year 2010)							
Based on National Average Values for Unit Consumption and Energy Price--Relative to EPCA 1992							
Payback Period (yrs)			NA	6.4	NA	11.7	13.8
Cost of Saved Energy ($/MMBtu)			NA	$3.905	NA	$7.104	$8.400
NPV (= LCC Savings) ($)			$0	$319	NA	-$622	-$2,397
Internal Rate of Return			NA	13.0%	NA	3.2%	0.9%
Based on National Average Values for Unit Consumption and Energy Price--Relative to Standard 90.1-1999							
Payback Period (yrs)			NA	6.4	NA	11.7	13.8
Cost of Saved Energy ($/MMBtu)			NA	$3.905	NA	$7.104	$8.400
NPV (= LCC Savings) ($)			$0	$319	NA	-$622	-$2,397
Internal Rate of Return			NA	13.0%	NA	3.2%	0.9%
Break-even cost multiplier				1.407	NA	0.774	0.654
		Aggregate Measures					
National Energy Consumption			**Trillion Btu (Primary)**				
2010	61.3	61.3	61.3	59.1	NA	57.0	52.2
2020	139.6	139.6	139.6	134.5	NA	129.9	118.8
2030	154.2	154.2	154.2	148.6	NA	143.5	131.3
Cumulative, 2004-2030	2,822.2	2,822.2	2,822.2	2,720.2	NA	2,625.3	2,401.9
Emissions			**Million Metric Tons**				
Carbon (MMtons)	42.3	42.3	42.3	40.8	NA	39.5	36.2
NOX (MMtons)	0.3	0.3	0.3	0.3	NA	0.3	0.3
Discounted LCC for Nation			**Millions of 1998 $**				
from Market Segments	6,516.4	6,516.4	6,516.4	6,471.1	NA	6,596.0	6,830.8
National NPV							
Relative to EPCA 1992			0.0	45.3	NA	-79.6	-314.4
Relative to 90.1-1999				45.3	NA	-79.6	-314.4

Quick Calc with National Averages (2010) ***(Note: Energy price fixed at 2010 value)***

	EPCA 1992	Market Baseline	Standard 90.1-1999	Test Level 1	TestLevel2	TestLevel3	MaxAvail
Energy Price ($/MMBtu)	$5.530	$5.530	$5.530	$5.530	$5.530	$5.530	$5.530
Ann. Energy Use (MMBtu)	608	608	608	586	NA	566	518
Standby Losses (MMBtu)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy cost, $/yr	$3,364	$3,364	$3,364	$3,243	NA	$3,130	$2,863
PV (energy cost)	$30,642	$30,642	$30,642	$29,534	NA	$28,504	$26,078
Equipment Cost	$5,368	$5,368	$5,368	$6,150	$0	$8,113	$12,299
Unit LCC	$36,010	$36,010	$36,010	$35,684	NA	$36,618	$38,377
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Product: **Instantaneous Tank Type Wtr Htr, Gas, 500 kBtu/h**

Output Capacity (Btu/hr)	385,000	Estimated Shipments in 1999	2,230
Lifetime (years)	7	Projected Shipments, 2004-2030	71,569
Equip. Price Markup	25%		

Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	Test Level 1	TestLevel2	TestLevel3	MaxAvail
Thermal Efficiency (%)	77.0	77.0	80.0	82.0	82.0	86.0	94.0
Standby Loss (Btu/hr)	1649	1649	1725	1725	1667	1110	1110
Equip. Price (w/o markup)	$5,466	$5,466	$5,747	$6,027	$6,059	$9,730	$12,055
Equip. Price (w/ markup)	$6,833	$6,833	$7,184	$7,534	$7,574	$12,162	$15,069
Year of Standard	NA	NA	2004	2004	2004	2004	2004

LIFE CYCLE COST (LCC) SAVINGS, for 2010	**1998 Dollars per Unit**				
Savings relative to EPCA 1992					
Weighted Average LCC Savings	-$24	-$159	-$185	-$4,236	-$6,441
Max LCC Savings	$333	$424	$401	$0	$0
Min LCC Savings	-$215	-$470	-$498	-$4,783	-$7,380
Percentage of units with LCC savings > 0	42.2%	42.2%	40.6%	0.0%	0.0%
NATIONAL ENERGY SAVINGS	**Trillion Btu (Primary)**				
Relative to EPCA 1992					
2010	0.2	0.3	0.3	0.7	1.1
2020	0.2	0.4	0.4	0.7	1.2
2030	0.2	0.4	0.4	0.8	1.4
2004-2030	5.3	8.8	9.0	17.7	29.1
Relative to Standard 90.1-1999					
2010		0.1	0.1	0.5	0.9
2020		0.1	0.2	0.5	1.0
2030		0.2	0.2	0.6	1.1
2004-2030		3.5	3.7	12.4	23.8
EMISSIONS REDUCTIONS (2004-2030)	**Million Metric Tons**				
Relative to EPCA 1992					
Carbon Equivalent	0.1	0.1	0.1	0.3	0.4
NOx	0.00	0.00	0.00	0.00	0.00
Relative to Standard 90.1-1999					
Carbon Equivalent		0.1	0.1	0.2	0.3
NOx		0.00	0.00	0.00	0.00
NET PRESENT VALUE (NPV) @ Discount Rate of 7.0%	**Million 1998 Dollars**				
Relative to EPCA 1992	-$0.6	-$4.0	-$4.6	-$105.7	-$160.7
Relative to Standard 90.1-1999		-$3.4	-$4.0	-$105.0	-$160.1

Adjust AEO Fuel Prices:	Multiplier:	1.00	Adder ($/MMBtu):	$0.000
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Product:	Instantaneous Tank Type Wtr Htr, Gas, 500 kBtu/h				Supplemental Results		
Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	Test Level 1	TestLevel2	TestLevel3	MaxAvail
Thermal Efficiency (%)	77.0	77.0	80.0	82.0	82.0	86.0	94.0
			Key Results: Per Unit Basis				
Input Capacity (MMBtu/hr)	0.500	0.500	0.481	0.470	0.470	0.448	0.410
National Ave FLEOH	610.4	610.4	610.4	610.4	610.4	610.4	610.4
Life-Cycle Costs: 1) wgted market segments , 2) w/nat. ave. energy price					2010 Ave. Energy Price=		$5.530
1) Wgted LCC	$16,433	$16,433	$16,457	$16,592	$16,618	$20,668	$22,874
2) LCC/ave energy price	$16,283	$16,283	$16,312	$16,450	$16,476	$20,535	$22,751
Measures of Investment Performance For Efficiency Levels Exceeding EPCA 1992 (for Year 2010)							
Based on National Average Values for Unit Consumption and Energy Price--Relative to EPCA 1992							
	Payback Period (yrs)		5.9	7.0	7.3	26.5	25.0
	Cost of Saved Energy ($/MMBtu)		$6.011	$7.235	$7.452	$27.219	$25.645
	NPV (= LCC Savings) ($)		-$30	-$168	-$194	-$4,252	-$6,469
	Internal Rate of Return		4.5%	-0.3%	-1.0%	NA	NA
Based on National Average Values for Unit Consumption and Energy Price--Relative to Standard 90.1-1999							
	Payback Period (yrs)		NA	8.9	9.3	35.3	29.2
	Cost of Saved Energy ($/MMBtu)		NA	$9.083	$9.494	$36.221	$30.004
	NPV (= LCC Savings) ($)		$0	-$138	-$164	-$4,223	-$6,439
	Internal Rate of Return		NA	-5.7%	-6.7%	NA	NA
	Break-even cost multiplier			0.606	0.580	0.152	0.183
			Aggregate Measures				
National Energy Consumption			**Trillion Btu (Primary)**				
2010	5.9	5.9	5.7	5.6	5.6	5.3	4.8
2020	6.6	6.6	6.3	6.2	6.2	5.8	5.3
2030	7.2	7.2	7.0	6.8	6.8	6.4	5.9
Cumulative, 2004-2030	155.4	155.4	150.1	146.6	146.4	137.7	126.3
Emissions				**Million Metric Tons**			
Carbon (MMtons)	2.4	2.4	2.3	2.3	2.3	2.1	2.0
NOX (MMtons)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Discounted LCC for Nation				**Millions of 1998 $**			
from Market Segments	544.3	544.3	544.9	548.3	548.9	649.9	705.0
National NPV							
Relative to EPCA 1992			-0.6	-4.0	-4.6	-105.7	-160.7
Relative to 90.1-1999				-3.4	-4.0	-105.0	-160.1

Quick Calc with National Averages (2010) ***(Note: Energy price fixed at 2010 value)***

Energy Price ($/MMBtu)	$5.530	$5.530	$5.530	$5.530	$5.530	$5.530	$5.530
Ann. Energy Use (MMBtu)	305	305	294	287	287	273	250
Standby Losses (MMBtu)	13.4	13.4	14.1	14.1	13.6	9.0	9.0
Energy cost, $/yr	$1,762	$1,762	$1,702	$1,663	$1,660	$1,561	$1,433
PV (energy cost)	$9,498	$9,498	$9,175	$8,961	$8,947	$8,415	$7,722
Equipment Cost	$6,833	$6,833	$7,184	$7,534	$7,574	$12,162	$15,069
Unit LCC	$16,331	$16,331	$16,359	$16,496	$16,522	$20,577	$22,790
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Product:	**Electric (120 gal)**						
Output Capacity (Btu/hr)	61,091			Estimated Shipments in 1999			23,387
Lifetime (years)	7			Projected Shipments, 2004-2030			750,572
Equip. Price Markup	25%						

Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	Test Level 1	TestLevel2	TestLevel3	MaxAvail
Thermal Efficiency (%)	99.0	99.0	99.0	99.0	0.0	0.0	0.0
Standby Loss (Btu/hr)	343	343	403	348	0	0	0
Equip. Price (w/o markup)	$1,862	$1,862	$1,862	$1,900	$0	$0	$0
Equip. Price (w/ markup)	$2,328	$2,328	$2,328	$2,375	$0	$0	$0
Year of Standard	NA	NA	2004	2004	2004	2004	2004
LIFE CYCLE COST (LCC) SAVINGS, for 2010				**1998 Dollars per Unit**			
Savings relative to EPCA 1992							
Weighted Average LCC Savings			-$49	-$51	NA	NA	NA
Max LCC Savings			$0	$0	NA	NA	NA
Min LCC Savings			-$67	-$52	NA	NA	NA
Percentage of units with LCC savings > 0			0.0%	0.0%	0.0%	0.0%	0.0%
NATIONAL ENERGY SAVINGS				**Trillion Btu (Primary)**			
Relative to EPCA 1992							
2010			-0.3	0.0	NA	NA	NA
2020			-0.3	0.0	NA	NA	NA
2030			-0.3	0.0	NA	NA	NA
2004-2030			-6.4	-0.5	NA	NA	NA
Relative to Standard 90.1-1999							
2010				0.2	NA	NA	NA
2020				0.2	NA	NA	NA
2030				0.3	NA	NA	NA
2004-2030				5.9	NA	NA	NA
EMISSIONS REDUCTIONS (2004-2030)				**Million Metric Tons**			
Relative to EPCA 1992							
Carbon Equivalent			-0.1	0.0	NA	NA	NA
NOx			0.00	0.00	NA	NA	NA
Relative to Standard 90.1-1999							
Carbon Equivalent				0.1	NA	NA	NA
NOx				0.00	NA	NA	NA
NET PRESENT VALUE (NPV) @ Discount Rate of		7.0%		**Million 1998 Dollars**			
Relative to EPCA 1992			-$13.0	-$13.3	NA	NA	NA
Relative to Standard 90.1-1999				-$0.3	NA	NA	NA

Adjust AEO Fuel Prices:	Multiplier:	1.05	Adder ($/kWh):	$0.000	
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Product:	Electric (120 gal)				*Supplemental Results*		
Efficiency Level ---->	EPCA 1992	Market Baseline	Standard 90.1-1999	Test Level 1	TestLevel2	TestLevel3	MaxAvail
Thermal Efficiency (%)	99.0	99.0	99.0	99.0	0.0	0.0	0.0
			Key Results: Per Unit Basis				
Input Capacity (kW)	18.086	18.086	18.086	18.086	NA	NA	NA
National Ave FLEOH	844.2	844.2	844.2	844.2	844.2	844.2	844.2
Life-Cycle Costs: 1) wgted market segments , 2) w/nat. ave. energy price					2010 Ave. Energy Price=		$0.067
1) Wgted LCC	$8,025	$8,025	$8,074	$8,076	NA	NA	NA
2) LCC/ave energy price	$8,028	$8,028	$8,078	$8,079	NA	NA	NA
Measures of Investment Performance For Efficiency Levels Exceeding EPCA 1992 (for Year 2010)							
Based on National Average Values for Unit Consumption and Energy Price--Relative to EPCA 1992							
Payback Period (yrs)			0.0	-60.3	NA	NA	NA
Cost of Saved Energy ($/kWh)			$0.000	-$0.747	NA	NA	NA
NPV (= LCC Savings) ($)			-$49	-$51	NA	NA	NA
Internal Rate of Return			NA	NA	NA	NA	NA
Based on National Average Values for Unit Consumption and Energy Price--Relative to Standard 90.1-1999							
Payback Period (yrs)			NA	5.5	NA	NA	NA
Cost of Saved Energy ($/kWh)			NA	$0.068	NA	NA	NA
NPV (= LCC Savings) ($)			$0	-$1	NA	NA	NA
Internal Rate of Return			NA	6.1%	NA	NA	NA
Break-even cost multiplier				0.969	NA	NA	NA
		Aggregate Measures					
National Energy Consumption			**Trillion Btu (Primary)**				
2010	29.6	29.6	29.8	29.6	NA	NA	NA
2020	31.0	31.0	31.3	31.1	NA	NA	NA
2030	32.5	32.5	32.8	32.5	NA	NA	NA
Cumulative, 2004-2030	740.7	740.7	747.1	741.2	NA	NA	NA
Emissions			**Million Metric Tons**				
Carbon (MMtons)	11.9	11.9	12.0	11.9	NA	NA	NA
NOX (MMtons)	0.1	0.1	0.1	0.1	NA	NA	NA
Discounted LCC for Nation			**Millions of 1998 $**				
from Market Segments	2,830.8	2,830.8	2,843.8	2,844.1	NA	NA	NA
National NPV							
Relative to EPCA 1992			-13.0	-13.3	NA	NA	NA
Relative to 90.1-1999				-0.3	NA	NA	NA

Quick Calc with National Averages (2010) ***(Note: Energy price fixed at 2010 value)***

	EPCA 1992	Market Baseline	Standard 90.1-1999	Test Level 1	TestLevel2	TestLevel3	MaxAvail
Energy Price ($/kWh),	$0.067	$0.067	$0.067	$0.067	$0.067	$0.067	$0.067
Ann. energy use (kWh)	15,267	15,267	15,267	15,267	NA	NA	NA
Standby Losses (kWh)	795.8	795.8	935.0	807.4	0.0	0.0	0.0
Energy cost, $/yr	$1,074	$1,074	$1,083	$1,074	NA	NA	NA
PV (energy cost)	$5,786	$5,786	$5,836	$5,790	NA	NA	NA
Equipment Cost	$2,328	$2,328	$2,328	$2,375	$0	$0	$0
Unit LCC	$8,114	$8,114	$8,164	$8,164	NA	NA	NA
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